Natural Science

A Monthly Review of Scientific Progress

NOVEMBER 1899

NOTES AND COMMENTS.

Disturbing the Balance of Nature.

No one who has appreciated the reality of the struggle for existence is likely to be in haste to disturb the balance of nature either by eliminating old-established inhabitants from an area in which they have settled, or by artificially introducing new-comers. But where the scientific man would try at least to act warily, the practical man is impetuous, and many illustrations of nemesis, *e.g.* the rabbits in Australia, are well-known. Nor has the scientific man always restrained himself from eliminating and introducing, and though the results have sometimes been beneficial, it has not always been so.

Apart from its practical importance, man's agency as an eliminator and distributor is of much theoretical interest, for the results serve to vivify our realisation of the struggle for existence, and often to impress us with the plasticity of adaptation which even highly specialised forms have still in reserve. It may be profitable, therefore, to bring together a few illustrations.

In 1850 the first house sparrows of Europe were introduced into America, and from that time to 1870, according to Merriam and Barrows (U.S. Department of Agriculture, Division of Economic Ornithology and Mammalogy, Bulletin I. 1889), upwards of 1500 are said to have been imported. They found themselves in conditions where the operation of natural selection was, in great measure, suspended as far as they were concerned. Commenting on this, Prof. Hermon C. Bumpus says (*Biol. Lectures Woods Holl*, Boston, 1898, pp. 1-15):—"They have found abundant food, convenient and safe nesting-places, practically no natural enemies, and unrivalled means of dispersal. Aside from an early and brief period of fostering care, they have been left to shift for themselves; natural agencies have since been at work, and in the relatively short space of forty years a continent has been not merely invaded, but inundated by an animal which, in its native habitat, has been fairly subservient to the regulations imposed by competing life." They may here and there recognise

their debt to man by destroying a few weeds, they may by their chirping cheer the heart of the simple, and they have enabled Mr. Bumpus to make an interesting study on variation, but on the whole they are a pest. Mr. Palmer, to whose article on dangerous introductions we shall immediately refer, says that the English bird "is now present in every state and territory, with half a dozen exceptions, and is known as a pest to nearly every one in the eastern United States. It has begun to spread in Argentina, while in Australia it is even more troublesome than in this country. It has also gained a foothold in Hawaii and numerous islands in the Atlantic, Pacific, and Indian Oceans." Most vigorous attempts have been made to get rid of it, *e.g.* the attempt last spring to expel it from Boston Common, but the sparrow holds its own. It is to be hoped that the proposal to introduce the English starling to counteract the English sparrow will not commend itself, for the evidence of antagonism seems very slim, and the cure might be worse than the disease.

In an article by T. S. Palmer, entitled "The Danger of introducing Noxious Animals and Birds," in the *Year-book of the Department of Agriculture* (U.S.A.) for 1898 (pp. 87-110, illustrated), of which the author gives an abstract in *Science* (x. 1899, pp. 174-176), some good examples will be found.

The mongoose, introduced into Jamaica in 1872 to keep down the rats, has multiplied like the rabbits in Australia and New Zealand, and while effectually reducing the rats, has proceeded to a wholesale destruction of poultry, game, ground-nesting birds of various kinds, reptiles, and even fruits. "The decrease of birds was followed by a marked increase in certain insect pests, but recent reports indicate that the mongoose is diminishing somewhat in numbers, and some of the birds are increasing, so that both native and introduced species are adapting themselves to new conditions." In Hawaii the record is similar, but the mongoose has not yet become such a nuisance as in Jamaica.

In the *Scientific American* for August 26, 1899, p. 140, Dr. C. M. Blackford recalls some other instances. In 1868 Leopold Trouvelot, an entomologist, was unfortunate enough to allow some imported gypsy moths (*Porthetria dispar*) to escape through an open window. In twenty years they had become a scourge, and we have more than once in our columns referred to their devastations and to the immense sums which have been expended in trying to counteract them. It is at last possible to say that the pest is under control, but the cost of its suppression has been enormous.

A happier instance of introduction is found in the well-known story of the fluted scale (*Icerya purchasi*) brought to California from Australia to the great damage of the orange and lemon groves, but effectively checked by the further introduction of the red "lady-bug" or vedalia (*Novius cardinalis*). "Within a short space of time the

trees were cleared, and at present the scales are being reared to preserve the lady-bugs in case of another outbreak." In 1897, in Portugal, the experience of the United States was successfully repeated.

From Dr. Blackford's article we may take one other example: "In many of the rivers of Brazil a plant grows that is called the Water Hyacinth. It is very ornamental, and a few years ago a land-owner on the St. John's River, in Florida, procured a small number for a pond on his estate. They increased rapidly and filled up the pond, whereupon the owner had them gathered up and thrown into the river. The experiment was unfortunate. Free from natural enemies, the hyacinths have flourished, so that on many streams navigation is practically impossible. From shore to shore there spreads an impenetrable sheet of vegetation that entangles paddles, oars, or propellers, and arrests all manner of refuse that should go to the sea. From time to time bodies of this growth become detached and drift down until salt water is reached, when the plants die and are cast ashore in putrescent heaps. A natural enemy has been sought, but as yet no appreciable result has been accomplished. In Brazil a small red spider lives on the hyacinths, and is said to be injurious to it. This spider has been introduced into Florida, but no effect has been perceived."

In conclusion, the theoretical interest of these cases is all very well, but "things are in the saddle," and practical considerations force themselves upon us. Therefore we have pleasure in quoting the last paragraph of Mr. Palmer's article. "Congress should take steps promptly to protect Hawaii and Puerto Rico against further introduction of noxious species, and to prevent the mongoose from being brought into the United States. The introduction of exotic mammals and birds should be restricted by law, and should be under the control of the U.S. Department of Agriculture. The wild rabbit, the mongoose, the flying foxes, and the mina of the Old World, should be rigidly excluded; and species of doubtful value, such as the starling, skylark, kohlmeise, and blackbird, should be imported with the greatest care, and only in places where they can be controlled in case they prove injurious."

Notes on American Mammals.

Mr. D. G. Elliot, so well known from his magnificent illustrated monographs of various groups of animals, as well as from his less pretentious handbooks of North American game and water birds, has recently turned his attention to faunistic work. The results of his labours have been presented to the public in the "Publications of the Field Columbian Museum," and comprise the mammalian fauna of the Olympic mountains, notes on certain reptiles and batrachians from the

same district, and descriptions of apparently new mammals from Oklahoma and Indian territory. Since the author is by no means addicted to unnecessary "splitting," it may be taken for granted that such forms as receive new names are certainly entitled to distinction.

To mention any of the smaller animals by name would be of no general interest; and we may therefore direct attention to his account of the Western Wapiti, which has only recently been brought to the notice of naturalists, although described long ago by Hamilton Smith under the name of *C. occidentalis.* Mr. Elliot regards it as merely a local variety of the Wapiti, and accordingly refers to it as *C. canadensis occidentalis.*

Failing to find any satisfactory characters in the antlers whereby it can be distinguished from the typical Eastern Wapiti, the author turns to the coloration of the animal, and writes as follows:—"In nearly all seasons of the year, except winter, the colour of the coat is apparently indistinguishable from that of the Rocky Mountain species, and I have seen a number of heads, killed in winter, that resembled precisely the Eastern animal, being in no wise any darker. But, as a rule, I believe in winter the head and neck of the Olympic Wapiti, together with the legs, reaching to the groin and rump, are black, varying in intensity and in a mixture of brown, among different individuals. This peculiar coloration I have never seen in the Eastern Wapiti, and when in this pelage the Olympic animal would be always readily recognisable. It is to be expected that all the animals inhabiting a country subjected to such an annual rainfall as in north-west Washington, would be very dark in appearance, and this is almost universally the case, all colours being intensified; and it is not surprising that the Wapiti should prove to be no exception to the rule, but assumes at certain seasons a partly black pelage. This colouring is practically the only character there is by which the Wapiti of the Olympics and Rocky Mountains can be separated, and when it is absent the animals are indistinguishable from each other."

In the geological series of the same journal (i. p. 181) Mr. E. S. Riggs describes certain Rodent remains from the Miocene of North America, which he refers to the hitherto imperfectly known family *Mylagaulidæ.* This family was established by the late Professor Cope on the evidence of jaws from the Upper Miocene of Nebraska described as *Mylagaulus.* The other forms, respectively from the Deep River and John Day beds, are named *Mesogaulus* and *Protogaulus.* Although showing some dental characters approximating to the Porcupines, these Rodents are regarded as undoubted Sciuromorphs, allied to the *Castoridæ*, although to a great extent forming an isolated type. "The one prominent feature," writes Mr. Riggs, "is the unusual development of the premolar, to the exclusion of the posterior-lying teeth. Associated with this is the great strength and sharpness of the mandible, the prominence and anterior position of the masseteric ridge, and the

depth of the ramus from the alveoli to the angle. These tell an unmistakable story;—unusual capacity for crushing or grinding, and the attendant specialisation of the premolar to perform the function laid upon it. Just as in the Carnivora, the first lower molar, lying immediately anterior to the insertion of the masseter muscles, has developed into the great shearing tooth; so in these forms the last premolar has fitted itself for a crushing implement, which has reached the highest degree of specialisation known to Rodentia." It is then suggested that the teeth in question may have been employed for cracking nuts or hard-shelled seeds, although evidently also used for grinding.

The 15th part of the "North American Fauna" is devoted to a monograph of the genus *Zapus* (jumping-mice), the range of which has recently been increased by the discovery of a species in North-West China. Mr. E. A. Preble is the author of the memoir in question, and appears to have done his work well.

The naturalists of the La Plata Museum appear convinced that the so-called *Neomylodon listai*—the ground-sloth, whose skin has been discovered in a cave in Patagonia—is really inseparable from the genus *Glossotherium*, or *Grypotherium*, and conclude that it was kept in a domestic state by the early inhabitants of Patagonia. They further believe it to be now extinct. The first instalment of a conjoint paper on the subject is published in the *Rev. Mus. La Plata*, vol. ix. p. 407.

American Plant-Notes.

RECENT numbers of *Rhodora*, the journal of the New England Botanical Club, maintain the reputation of this small but useful periodical. Among numerous notes and short papers dealing chiefly with the native flora, we note some suggestions on seaweed collecting by F. S. Collins, and an account of past and present floral conditions in Central Massachusetts by G. E. Stone. The last mentioned traces the effects of deforestation on the flora, especially with regard to the proportion and nature of the trees. Several species, such as the hemlock, beech, and canoe-birch have become less abundant, their places being more or less occupied by the quicker growing white birch and poplar. The complete and continual removal of forest has also exerted a great influence upon many smaller plants, and there is a marked decline in the luxuriance of humus-loving orchids, strawberries and meadow-grasses.

The July number of the *Plant World* contains a picture and short account of the liberty tree of Annapolis, an ancient and magnificent tulip-tree with numerous and various historic associations. There is also a laudatory exposition of ecology, or the study of the relation of

plants to their surroundings as a branch of botany worthy the attention of teachers and students.

With the July number the *Botanical Gazette* enters on a new volume (xxviii). The issue contains three important papers. "Studies on Reduction in Plants," by G. F. Atkinson, describes the intra-nuclear changes occurring during pollen development in an aroid (*Arisaema triphyllum*), and a liliaceous plant (*Trillium grandiflorum*). The author suggests that "some of the bewilderment which now surrounds certain phases of the study of the morphology of the nucleus" will disappear, "if we recognise that there is such a thing as a reducing division or qualitative reduction in plants as represented by such types as *Trillium*, *Arisaema*," and others; "that there are plants in which only a quantitative or numerical reduction occurs," as in *Podophyllum*; "and possibly that there is still another type where in the same plant qualitative reduction may take place in some cells, while quantitative or numerical reduction only takes place in others." The paper is fully illustrated. Charles Robertson adds another (No. xix.) to his long list of papers on "Flowers and Insects." He deals chiefly with the flower visits of oligotropic bees, those, namely, which restrict their visits for pollen-collecting to a few flowers. Oligotropic species are more frequent than has hitherto been supposed, and the author gives a list of fifty-two belonging to thirteen genera, the number of plant species visited varying from one to nine. He also discusses the influence of bees in the modification of flowers, tracing the origin of pollination by insects, and the development of increasingly complex mechanism, as the result of insect-visits.

The "Origin of the Leafy Sporophyte" is a critical contribution by Prof. J. M. Coulter, to the much debated question of the development of the higher leaf-bearing plant from the moss-capsule or some one or more ancestors. The argument from cytology is not yet clear, and the author is fain to admit that, on the whole, all such discussion is "very vague and general, and may not commend itself to many as profitable."

We have received a separate copy, printed in advance from the eleventh annual report of the Missouri Botanical Garden, of a revision of the North American species of *Euphorbia*, belonging to the section *Tithymalus*. Most of our British spurges belong to this section, and nearly all of them have been introduced into the United States and have become more or less widely spread there. The paper, which is by J. B. S. Norton, is accompanied by no less than forty-two plates showing the general habit of the plant, with floral dissections and figures of the seeds. We have so often to deplore the absence of figures in systematic books and papers that we are glad to note an example of a monograph in which every species is figured.

A Rock out of Place.

IN the July-August number of the *Journal of Geology* (vii. pp. 483-488) Stuart Weller describes the peculiar occurrence of a small patch of Upper Devonian rock in the heart of a quarry of Niagara limestone at Elmhurst, Illinois. At this locality the limestone is much fractured, and one of the joints is enlarged to form a cavity, triangular in section, 6 inches wide at the base and 16 inches high, but thinning out as it passes into the rock. This cavity is filled with angular fragments of the adjacent limestone embedded in a dark brown sandy matrix, which contains fish-teeth, *Lingula*, and other brachiopods, the total suggestive of a late Devonian age. From this material two new species of *Diplodus* are described by C. R. Eastman in the same number of the *Journal*. Further, says Dr. Weller, "At the base of the triangular opening, between the two beds of limestone that come in contact at that point, the Devonian material extends both to the right and left for several feet, forming a bed an inch or two in thickness between the two limestone beds."

The nearest outcrop of Devonian is 80 miles from Elmhurst, so that the position of this patch is doubly interesting. Dr. Weller explains it thus. During the greater part of Devonian time the region must have been above sea-level (an inference which seems to follow legitimately from the alleged age of the deposit). "The waters which collected upon this land surface in part percolated through the underlying rock strata and by solution increased the size of many joint cracks. At a later period, near the close of the Devonian, when the sea again occupied the region, sand was sifted down into these open joints, and with it the teeth of fishes which inhabited the sea thereabout." The opening was, "perhaps, large enough for the entrance of some of these fishes." Traces of the same sandy material are seen on the joint-face above the opening.

If this explanation be true, then, as Dr. Weller phrases it, "no description of any similar occurrence has been observed in the literature"; but this scarcely justifies the conclusion of the sentence, "and it may be designated by the name subterranean unconformity." If the mode of occurrence were at all common, if it were anything but unique, then perhaps a name might be convenient. At present there seems no advantage in one. Moreover, we are not convinced that Dr. Weller's account is the true one. It does not allude to the occurrence of clay in the other joints, and it affords no explanation of the limestone breccia. Can Dr. Weller prove that this is not a fault-rock, in which fragments of the immediately adjacent rock are mixed up with fragments or washings that have fallen down the crack from the superjacent rock? Such an occurrence is common enough, though we know no technical name for it.

Beeren Eiland.

THE Swedish Arctic Expedition of 1898, under the leadership of Prof. A. G. Nathorst, spent a week on Beeren Eiland, mapped it on a scale of 1 : 50,000, and made numerous observations on its natural history. Chief among these were the geological researches which proved a prehistoric local glaciation, and by means of fossils showed the presence of rocks of three systems: Silurian, Middle Carboniferous, and Trias, previously unknown on the island. These discoveries led to another expedition to Beeren Eiland during the past summer. The expenses were borne by the Vega Stipend of the Swedish Geographical Society, the Lars Hierta Memorial Fund, and various private individuals. The leader was the geologist, J. Gunnar Andersson of Upsala, who had accompanied Prof. Nathorst; the other scientific members were C. A. Forsberg, cartographer and meteorologist, and G. Swenander, zoologist and botanist. The expedition stayed on Beeren Eiland from June 23 to August 19, and accomplished the following work:—

The whole island was mapped in greater detail, and a special map, on a scale of 1 : 5000, was made of Rysshamn, where the expedition had its headquarters.

From June 25 to August 16 complete meteorological observations were taken twice a day, as well as continuous observations by a self-registering barometer and thermometer. Eight series of observations were made on the tides, each series extending over from 8 to 51 hours, during which time the height of the water at intervals of half an hour was marked off on a section.

The botanist collected all the phanerogams previously found on the island as well as *Koenigia islandica*, hitherto unrecorded. Exhaustive collections were also made of the lower plants, including the algae of red and green snow. To investigate the influence on plant-growth of the continuous light of an Arctic summer, three series of cultivation experiments were carried out as follows:—First, in five places of nearly the same longitude, but at a distance of about 3 or 4 degrees of latitude from one another—namely, Svalöf in Scania, Ultuna near Upsala, Luleå, Tromsö, and Beeren Eiland — barley taken from the same sample was grown in soil from the same place. Only the climatic conditions, and especially those of light, were different in the different stations; thus there were completely dark nights in Scania, complete light the whole 24 hours on Beeren Eiland, with intermediate conditions at the intervening places. The material from the Scandinavian stations has not yet been brought in, so that the results of this interesting experiment are still awaited. Secondly, on open land at the Beeren Eiland station there were cultivated two precisely similar series of Arctic plants, of which one series stood in continual light, while the other was kept in complete darkness each night (8 P.M. to

8 A.M.). During the period of the experiment the development of these plants did not proceed very far, but the series kept in the light was obviously the more sturdy. The third experiment consisted in the cultivation, on a hot-bed, of a score of common Scandinavian plants. These also were in two similar series, one kept in the light, the other darkened by night. The experiment succeeded with 18, and of these 16 were clearly more sturdy in the light series, some of them yielding examples half as large again as those in the darkened series.

To the list of the island's fauna were added two birds: the Skua (*Lestris pomatorhina*) and the Spitzbergen form of *Mormon arcticus. Salmo alpinus* was found in a lake. Special attention was paid to the insects, which on isolated oceanic islands are of much interest to the student of distribution. Holmgren, the only entomologist who had previously visited Beeren Eiland, found there in 1868 only 9 species of Diptera and 1 Hymenopteron. The Swedish expedition has brought back a large collection of Diptera, not yet worked through, 4 Hymenoptera, 1 Neuropteron, and 2 Coleoptera. Holmgren found only 2 Acarids; the present explorers have at least 10.

The chief object of the expedition was a detailed geological investigation of the island. This has been successfully carried out with valuable results. A large collection of fossil plants from the coal-bearing series has been made; numerous fossils have been collected from all the marine strata, especially from the Trias. A geological map of the whole island has been constructed. The stratigraphy and tectonic geology of the whole island has been worked out, and there have been discovered in the southern part of the island a series of dislocations of Carboniferous age, which explain the topography of the hilly regions and the varying development of the Carboniferous system at various points.

Mr. Gunnar Andersson and his companions are to be congratulated on the amount of solid work they have accomplished, and we look forward to the publication of the detailed results with much interest. It should be mentioned that the proprietor of Beeren Eiland, Mr. Lerner (who happens to be a German) has helped the expedition, and hopes to welcome it back in some future year.

The Difficulties of the Australian Museum.

DESPITE the fact that the Australian Museum is in an unhappy financial position, we enjoy reading the report of its Curator, because Mr. R. Etheridge, junior, has a way of saying just what he thinks, and this way—the essence of all great literature—is not permitted to many officials in the mother country. Mr. Etheridge's vigour has

infected even the Trustees, and their Report for the year 1898 puts the case as strongly as can be expected from so decorous a body. They "regret that for some years past the funds voted for the maintenance of the museum have been inadequate. In 1892 the museum vote, leaving out of account special items, was £7201. In 1893 the trustees were compelled to submit to considerable reductions, rendered necessary by the financial pressure of the time, and they endeavoured to adapt their work to the rates allowed. They expected, however, that with returning prosperity, not only would former votes have been restored, but that some material consideration would have been given to the natural advancement of the institution." This has not been the case, since the appropriation for 1898-99, although showing slight increase, was over £2000 less than that for 1892. "As regards members of the scientific staff, no steps have been taken towards restoring the salaries to the rates existing before the retrenchment of 1893, although, in the public service generally, considerable increases have been granted to officers. In 1892 the vote for purchases was £1250; since 1893 only £200 a year have been allowed, including purchase of books as well as specimens." Such a sum would be ridiculously small for a metropolitan museum, if assigned to books alone. "Consequently, many desirable specimens have been lost to the Museum, and therefore to the Colony, while no collecting, so necessary for maintenance as well as increase of the exhibits, has been done, and the Library has also fallen into arrears. The insufficiency of the funds provided for the Museum by the statutory endowment of £1000 per annum, together with the irregularity both in amounts and in detail of the Annual Votes of Parliament, supplementary to the endowment, prevent anything like an effective promotion of the interests of science in connection with the natural history of the Colony. As those interests have an important relationship to the development of the resources, and, consequently, to the future prosperity of the community, the Trustees are exceedingly anxious to be placed in a better position for carrying out the purposes for which the Museum has been established."

With all this, needless to say, we heartily sympathise. We do not overlook the fact that last year a sum of £1500 was placed on the Estimates for certain much-needed repairs, or that on the Loan Estimates for 1898-99 a further sum of £13,500 has been voted for museum extension, the intention being to build the superstructure over the newly-erected workshops as a portion of the south wing. But we observe that "very great and unnecessary delay has arisen in the carrying out of the renovations," and we emphasise the contention of Mr. Etheridge that, as the collections and the buildings grow, it is necessary to increase the staff, and to provide at least sufficient money for cases and for locks to them. The admirable work carried out by this excellently-administered museum has often been alluded to by us,

and further information regarding it will be found in our news-pages. It would be a serious loss to the colony should the activities of the staff continue to be restricted, and should the valuable collections suffer yet further neglect.

The *Antarctic* in the Arctic.

THE Swedish expedition to the coast of East Greenland, under the leadership of Professor A. G. Nathorst, on board the ss. *Antarctic* (Captain Forssell), returned to Stockholm in September, having accomplished some excellent work. The ice at first was found to be heavy, so some time was spent in exploring Jan Mayen Island. As soon as the ice permitted, an advance was made in the direction of Shannon Island; but here again the ice prevented a passage from being forced, and the *Antarctic* steamed south to Scoresby Sound. Various observations and corrections of the chart were made here, Hurry Inlet being found closed to the north. The expedition then returned north, and this time succeeded in entering Franz Josef Fjord. This was found to extend very much less into the interior than shown on Payer's chart, and Petermann's Peak also was found to have about half the height assigned to it by Payer. To make up for this, the expedition discovered a new fjord system, with three branches, stretching south from the mouth of Franz Josef Fjord, to a distance equalling that of the great Sogne Fjord in Norway. To this Professor Nathorst has given the name Kung Oscar Fjord. Eight weeks were spent in investigating its shores and those of Franz Josef Fjord, and a map of them was made on the scale of 1 : 200,000. Among the interesting discoveries reported by Professor Nathorst is that of Devonian rocks with armoured fish. Silurian fossils also have been found. Several individuals of that curious animal, the musk-ox, were seen and shot. The flesh was found to have a muttony flavour with no unpleasant scent, and Professor Nathorst suggests the acclimatisation of the animal in northern Sweden. Polar bears and a few Arctic foxes also were seen by members of the expedition. Large collections of marine animals were made and are now being worked up in the Riksmuseum at Stockholm. Among the notable specimens is one of the pennatulid, *Umbellularia,* with a stem over six feet long. It was only in the accomplishment of its ostensible object, the finding of some trace of Andrée, that the expedition failed. Since the Royal Geographical Society contributed £100 to the expense, we shall doubtless be able to read further details in its *Journal.*

Regeneration in Orthoptera.

Mr. Edmund Bordage, of Réunion, although recently laid aside by fever, continues to send home notes in regard to regeneration in Phasmidae, Mantidae, Blattidae, and other Orthoptera. Their theoretical interest is so great that we venture to refer at some length to two or three recent papers by this observer.

In twenty-five species of Orthoptera with five-jointed tarsus, representing twenty-one genera and three families, the regenerated tarsus has only four joints. The number given in his published paper is eighteen species, but a manuscript note on the copy sent us states it at twenty-five.

In *Phylloptera laurifolia* and *Conocephalus differens* (Locustidae), *Acridium rubellum* (Acrididae), and *Gryllus campestris* (Gryllidae), there is no trace of regenerative capacity in connection with the posterior legs, which are used in jumping. This appears at first sight an argument against the generality of Lessona's law, since these hind legs are surely much exposed to the bites of enemies, besides being liable to injury in the moults. Bordage's answer is that the loss of these limbs makes moulting extremely difficult, exposes the insects to great danger at the hands of their enemies, prevents copulation, and places the unfortunates at a great disadvantage in preferential mating. He concludes that jumping Orthoptera which have lost their hindmost legs are unable to propagate, and that this explains the absence of regenerative capacity in this particular case.

In another paper (*Comptes Rendus Acad. Sci. Paris*, cxxix. 1899, pp. 169-171), Bordage points out that it is impossible to provoke autotomy of the first two pairs of legs in saltatorial Orthoptera. By main force a separation may be effected at the articulation of trochanter and coxa, or rarely at the articulation of femur and trochanter. The mutilation is often fatal, but if the insect survives and is still larval, regeneration may be effected, perfectly if the separation was between femur and trochanter, more or less rudimentarily if between trochanter and coxa.

This raises a double difficulty for those who uphold Lessona's law:—(1) the regeneration seems to occur at points where mutilation cannot be naturally effected; and (2) the regeneration is most frequent and most complete when the separation has been effected along the line where rupture is rarest.

Bordage gets over the difficulty by pointing out that in the "exuvial autotomy," *i.e.* self-mutilation during a moult, the separation is most frequent along the femur-trochanter articulation, and very rare along the trochanter-coxa articulation. The bleeding is insignificant in the first case, but it may be fatal in the second. Moreover, regeneration in the first case is frequent, and, though slow, sometimes

perfect; but in the second case an unjointed stump is formed. There seems to be no appendage which may not suffer mutilation during the hazardous process of moulting.

In jumping Orthoptera, tarsal regeneration occurs readily on any of the legs, and this conforms with the fact that mutilation of the tarsus is peculiarly liable to occur during moulting. Experiment shows that the terminal portion of the tibia may also be regenerated, and this too may be associated with the fact that in exuvial mutilation or, more rarely, as the result of attack, the muscles at the end of the tibia are often torn when the tarsus is pulled off.

Bordage also notes that in *Phylloptera laurifolia* and *Conocephalus differens* the regenerated tarsus is tetrameral, as is normal in Locustidae, while in *Gryllus campestris* the regenerated tarsus has three joints. In Locustidae and Gryllidae the tibia of regenerated anterior legs does not possess the tympanic apparatus borne on the normal limb.

Diastataxy.

THE *Journal of the Linnean Society*—Zoology—for July, vol. xxvii., contains two very important contributions towards a solution of that ornithological puzzle known hitherto as "Aquinto-cubitalism." Mr. P. Chalmers Mitchell has approached the question from the point of view of comparative anatomy; Mr. W. P. Pycraft from that of embryology.

The riddle to be solved, it will be remembered, was the meaning of the constant absence of a remex from between the fifth pair of secondary major coverts of the wing in certain birds, or groups of birds. Wings in which this feather was wanting were known as aquinto-cubital; when there was no such deficiency the wing was known as "quinto-cubital."

Mr. Mitchell has proposed the term diastataxic for the former, and eutaxic for the latter. These terms are undoubtedly superior to the older ones, and have been adopted by Mr. Pycraft in his paper.

Till now, it was believed that in the diastataxic wing the fifth remex was missing; both the present authors agree, however, that this is not the case.

Mr. Pycraft endeavours to show that the remex in question has lost its original relations, but not its existence. According to him the diastataxial wing is at first eutaxic, changing more or less suddenly during development from the one into the other. This is brought about by a remarkable, but unmistakable shifting of position of all the coverts of the dorsal surface of the wing and of the remiges (1-4). The remiges in question move outwards (wrist-wards), and backwards, the movement being accompanied by certain of the obliquely transverse row of coverts (1-5). As a consequence, the fifth of these rows becomes

separated from its remex (the fifth), and comes to lie, in the adult, quill-less between quills—the fourth and fifth. The place of the fifth oblique row of coverts is now taken by the sixth which runs outwards, that of the sixth by the seventh, and so on inwards to the elbow, thus, each obliquely transverse row from the wrist inwards moves forward one place, as also do the remiges (1-4); the remainder appear to be stationary. Thus does the eutaxic wing become diastataxic.

Numerous figures of embryonic wings leave little doubt that this interpretation of the mystery is correct; what we want to know is "Why this shifting?"

Mr. Mitchell, in the pterylogical section of his paper claims to have proved that the diastataxic wing is architaxial, and not the eutaxic, as is held by Mr. Pycraft. He endeavours to support his claim by demonstrating the transition from diastataxy to eutaxy in the wings of certain pigeons—upon which group the whole of his observations are based.

This transition seems to be brought about by a shortening of the wing, and the obliteration of the usually more or less marked gap between the fourth and fifth remiges. But more than this; the crux of his paper rests upon the identity of certain covert feathers lying in the interspace between the fourth and fifth remiges just referred to. In certain of the pigeons he has examined, as in many other birds, the median coverts lie in the interspaces between the remiges. As a consequence, in the diastema between remiges 4-5 we have a major covert lying between two median coverts. In some pigeons two of these three feathers disappear, and the wing, according to Mr. Mitchell, becomes eutaxic. Assuming that the remaining covert is of the median series he has proved his contention. If, however, as he himself suggests, it is a major covert, his contention is only partly true. We have a pseudo-eutaxy. This last point is one of very considerable importance, for it may happen that, after all, the apparently eutaxic forms which occur amongst diastataxic groups may prove ultimately to be pseudo-eutaxic. At least this must be so, if we define diastataxy as that form of wing lacking a secondary remex from between the fifth pair of major coverts. This interpretation would be quite in harmony with Mr. Pycraft's paper. It is to be hoped that further research will be made in this part of the subject.

Immunity acquired before Birth.

It is of interest to students of heredity to note the observations of Messrs. Béclère, Chambon, Ménard, and Coulomb (*Comptes Rendus Acad. Sci. Paris,* cxxix. 1899, pp. 235-37), on sixty-five mothers and an equal number of newly-born children. The results make it

difficult to deny the justness of the interpretation that in certain cases there is a passage of antivirulent substance from the blood of a vaccinally-immune pregnant mother to the blood of the foetus, and that the child may be in consequence born immune.

The facts and arguments are briefly the following:—Immunity to vaccinal inoculation was observed only in children whose mothers were immune. Only in a small number of cases where the mother was immune was the child immune. The intra-uterine transmission occurred in cases where the maternal serum was antivirulent, irrespective of the period when the mother was vaccinated. On the other hand, the intra-uterine transmission was not observed in any case where the maternal serum was non-antivirulent, although vaccination had been effected shortly before or during pregnancy. Therefore the condition of so-called congenital immunity is the transmission of antivirulent substance from the maternal to the foetal blood through the placenta. But the condition may be fulfilled without result, for some of the newly born, whose serum was antivirulent, were still inoculated with success. In fact, the degree of antivirulent potency is variable, but it may be said that the more antivirulent the serum shows itself to be, the greater is the presumption that the vaccinal inoculation will fail to have effect.

Eel Poison and Cellular Immunity.

THE serum of eels is known to contain a "globulicidal" substance—ichthyotoxin, of course—which destroys the red blood-corpuscles of various animals into which it has been injected. The rabbit, for instance, is peculiarly susceptible; the red blood-corpuscles rapidly lose their haemoglobin by diffusion when the eel-serum is injected, even when it is diluted to $\frac{1}{10000} - \frac{1}{20000}$.

Messrs. L. Camus and E. Gley, who have investigated the subject (*Comptes Rendus Acad. Sci. Paris*, cxxix. 1899, pp. 231-233), find that the hedgehog is very immune, even against strong injections, and experiments show that this immunity is due, not to the presence of any "antiglobulicide" in the hedgehog's serum, but to the resistent power of the red blood-corpuscles themselves. They have a natural cellular immunity, wrongly called by the authors "immunité *cytologique*." (If words mean anything it should be *cellulaire*, but the mistake is a common one.)

The frog and the toad, the hen and the pigeon, and *Vespertilio murinus*, show the same cellular immunity. A peculiar fact is that newly born, still blind rabbits, are similarly resistent, but the power dwindles from the fifteenth day or so, and the adults have none. The experimenters, in their interesting paper, cite the case of a doe-rabbit

which was rendered immune, and had thereafter young ones. These proved to have cellular immunity, but the presence of an antiglobulicidal substance was detected in their serum, so that both natural cellular immunity and acquired "humoral" immunity were found co-existing in one organism. What next?

Venom of Vipers.

MANY wonderful things have been discovered of recent years in regard to the poison of snakes, such as the possibility of counteracting its toxic properties with the snake's own bile, but that there is still much to be discovered is evident from a recent communication from a well-known worker, C. Phisalix (*Comptes Rendus Acad. Sci. Paris*, cxxix. 1899, pp. 115-17).

He has shown that the secretion of the poison glands of *Vipera aspis* and other Viperidae contains a diastatic ferment or echidnase. This varies in amount according to habitat and season. Thus it is much more abundant in vipers of the Vendée than in those of Arbois (Jura); it is not demonstrable in the secretion in early spring after the hibernal period, but has become abundant by the end of May or the beginning of June. It is indeed present in the glands in spring, but the secretory cells are inactive and retain it.

A solution of the viper's poison in glycerine-water gradually loses its virulence, more quickly when the external temperature is high. It often happens that in ten to fifteen days the venom has become quite innocuous, and it is found that of its active principles the echidnase is most persistent. Moreover, when the echidnase is removed from the venom, the attenuation of the latter is much slower than usual. It is therefore logical to suppose that the echidnase plays an active part in the attenuation, directly attacking the venomous principle. Experiments show that this is really the case, and thus we reach the conclusion that the diastatic ferment of Viperidae has a digestive effect not only on the tissues of the animals inoculated, but also on the active toxic substance, the echidno-toxin.

ORIGINAL COMMUNICATIONS.

Variation-Statistics in Zoology.[1]

By Dr. Georg Duncker.

Zoological and botanical objects have usually been regarded as isolated products of nature, to be described carefully and to be grouped, according to the degree of their morphological and ontogenetic likeness, under abstract conceptions, the systematic categories. Yet this customary manner of considering biological objects is insufficient, since individuals of any systematic category never occur isolated, but always in larger or smaller complexes or groups of individuals. For about ten years another point of view has been finding increased favour; it has been recognised that not only the morphological characters of single individuals, but especially those of the natural complexes of homogeneous individuals, are worthy objects of investigation. This kind of investigation takes the same place in zoology and botany as ethnography does in anthropology. In reference to its special aims, it has worked out its own methods, which in its various stages of development and different branches, may be summed up under the title *Statistics of Variation.* Let us briefly consider this method and its results.

In anthropology statistics of variation have been already utilised for forty or fifty years. This is partly due to the early scientific interest in the individual differences of the characters of man, and partly to the fact that the problems of this branch of biology cannot be solved by isolated observations made on single individuals, but require intensive investigations of the actual groups of individuals. This is evidently the case with racial problems in anthropology.

Primarily, zoology and botany are occupied in investigating the characters and development of individuals (anatomical morphology and embryology). We also find that the individuals, morphologically dissimilar, are classifiable, according to their degree of likeness, into higher or lower categories, which are regarded as elementary objects of scientific investigation (systematic zoology, comparative anatomy).

[1] Lecture delivered at the meeting of the Deutsche Zoologische Gesellschaft at Hamburg, May 1899.

That elementary complex of individuals, which is usually the starting-point for zoological and botanical investigations, is the species. More or less exclusively, all biological, systematic, and anatomical results are referred to this. But the species is by no means an elementary group; even if we omit its systematic sub-groups, the variety and the race, we find it empirically to be composed of individuals which are separated by space and time, and are allied to each other in different degrees of kinship. In those individuals of the same species there regularly occur morphological differentiations of their common characters, caused by constitutional factors (conditions of sex, stage of development) as well as by the sum total of recognisable external conditions of life (locality, geological formation, climate, food, etc.). Really elementary complexes of individuals, *eo ipso* coherent, are only those of which the morphological qualities have not been differentiated by any of the factors just enumerated. But even in such a "FORM-UNIT," as I have called it [7], we find on investigating the distinctive characters that there are individual differences.

Therefore the species is not elemental, a conclusion strengthened by the difficulty (bordering upon impossibility) of definition. It splits up in numerous variable form-units, produced by different factors, which frequently may be united into races or varieties. Each form-unit is a sum of more or less different individuals, the characters of which change in the course of development, that is, in time, but appear constant at a given moment, so that it is not justifiable to speak of varying or non-varying individuals. On the other hand, groups of individuals are variable in every moment of their existence and in each of their characters. Therefore *the fact of variation is to be seen only in the characters of groups of individuals,* and to be investigated only in these.

The exact study of variation affords a better understanding of the systematic relations between groups of individuals; it is a means of distinguishing pathological from normal states; but it owes its highest importance to its bearing on the theoretical explanation of the relations between organic individuals, *i.e.* in regard to heredity and evolution.

The objects of an investigation on variability are the characters of a complex of individuals and, according to the laws of induction, at first of the most primitive complex, the form-unit. The aim of this investigation is twofold; on the one hand qualitative, to discover the real individual differences in these characters, which we may call the *variants;* on the other, quantitative, to discover the relative frequencies of the single variants of each character determined.

The principal difference between a character of a single individual and one of a complex of individuals, therefore, consists in the possibility of expressing the former by a single variant, while the latter requires

not only several variants, but also their relative frequencies. Until now this necessity has generally been neglected. The characters of a group of individuals, *e.g.* of the species, have been described by uncritical generalisation of single results which were regarded as "typical" or "normal," or by average values got mostly from small numbers of observations, which naturally represent only idealised single results, or, in the best cases, by so-called "ranges of variation." The latter are merely chance results of observation without definitive value; they show the group to be variable, without indicating the manner of its variation. The only quantitative data we occasionally meet with are indefinite terms, such as "frequent" or "rare."

For determining not only the variants of comparable objects, but their frequencies as well, we must use statistics. Statistics are collections of single data, brought together according to certain points of view, of qualitative differences of numerous objects belonging to the complex to be investigated, and of the frequencies with which these differences occur.

In order to investigate the variation of any character of a form-unit, the character in question has to be determined in as many individuals of the form-unit as possible, the variants in which the character is found are to be noted, and finally the frequency with which each of these variants occurs, is to be determined. This method can be applied to every character, to conditions of shape and colour as well as to dimensional or numerical conditions of organs.

Then the first result as regards variation will be, that if the number of individuals investigated is not too small, the relative frequencies of the single variants of the character will be nearly constant in each lot of the same form-unit. For instance, when a character has been investigated thrice, each time in 500 individuals, and in all cases nearly equal percentages of its variants have been found, we may conclude, according to the law of great numbers, that in the whole form-unit also the variants are distributed in the same proportion. Secondly, closely allied form-units, *e.g.* the two sexes of the same breed and in a similar stage of development, may possibly agree in the mean and range of a character, and yet sensibly differ in the frequency distribution of its variants. Such differences of complexes of individuals are only to be made out by statistically examining the variability of their characters.

The statistical investigation of such characters as cannot be numerically expressed, like conditions of shape and of colour,[1] cannot go beyond this point. But in numerical characters, such as dimensions or numbers of homologous organs, the variants represent numbers which differ by constant values, the units of dimension or enumera-

[1] At present there is an increasing tendency to express numerically these conditions also; thus Davenport seeks to numerically determine colour-variations by the "colour-wheel" (*Science*, N.S. vol. ix. No. 220, p. 415-416).

tion. This done, the results may be further dealt with. Firstly, all the observed variants have to be arranged in series according to their numerical value, and the frequency of each among the (n) investigated individuals has to be determined. Thus we get the *empirical series of variation* of the character in n individuals. Weldon [20], for example, counted the number of the dorsal rostral teeth in 915 individuals of *Palaemonetes varians*, whence he got

Variants .	1	2	3	4	5	6	7 (rostral teeth)
Frequencies .	2	18	123	372	349	50	1 (individuals).

A series of variation may be graphically represented by noting the variants in the order of their numerical values as points of equal distances on an abscissa, and by erecting ordinates from each of these points which represent by their length the relative (percentage) frequencies of the corresponding variants. Straight lines drawn between the free ends of each two adjacent ordinates, together with the abscissa, will give the outline of the *polygon of variation* of the character. The average value of the character, that is, the arithmetical mean of the variants, corresponds to a point on the abscissa (M); the ordinate erected to the latter is the *centroid vertical* of the polygon (y_c). The summit of the polygon of variation usually lies near the centroid vertical; its variant has been called the *mode*; but the mode is neither more "typical" nor more "normal" than any other variant existing.

The single ordinates of frequency are generally lower the more distant they are from the centroid vertical. The polygon of variation is broad and low when there is great variability in the character, but high and narrow in the opposite case. The best and simplest expression of the degree of variability of a given character is the square root of the average square deviations of its variants from the mean. This value, which may be called the *index of variability* of the character (ϵ), corresponds to a piece of the abscissa; it is expressed by the same unit as the variants of the character. The above-cited series of variation of *Palaemonetes* has the index of variability, ·8627 rostral teeth.

While the average values of a character may differ widely in different form-units of the same species, the indices of variability remain fairly constant [1] not only in the form-units of the same species,

[1] Examples:

I. Number of fin rays in	dorsal fin		anal fin	
	M	ϵ	M	ϵ
of *Pleuronectes flesus*, Baltic			39·46	1·4838
,, ,, ,, North Sea			41·56	1·7739
,, ,, ,, Plymouth	61·7214	2·3895	43·6098	1·6026
,, ,, *americanus* (BUMPUS [4])	65·06	2·4467	48·62	1·8188
,, *Rhombus maximus* (PETERSEN [14])	62·98	2·2533	45·86	1·6792
II. Number of rostral teeth	dorsal		ventral	
in *Palaemonetes varians* (WELDON [20])	4·3137	0·8627	1·6948	0·4799
,, ,, *vulgaris*	8·2819	0·8145	2·9781	0·4477

but also in those of species belonging to different genera, even to different families. This fact does not seem to me to have been sufficiently regarded hitherto; the explanation of it is, I suppose, the constancy of the physiological capacity of a given organ for reacting to the individual causes of variation (to be considered afterwards) with respect to a given character. Some authors, however, seem to assume a more or less constant relation between the height of the average and that of the index of variability of a character.

Average value and index of variability of a numerical character are the first data necessary to the description of its variation. Both ought always to be determined; but they only give an approximate idea of the variation of the character. Its complete description requires the determination of the curve which rules the slope of its polygon of variation, or in other words, on which the corner points of the polygon are situated. To find this curve, we must find the mathematical relations between the variants or their deviations from the average value on one hand and their frequencies on the other.

There is a striking likeness, even at the first glance, between the polygons of variation and binomial polygons. We get the latter by graphically representing the series of summation which arise by developing binomial terms, as $(p+q)^t$. As a matter of fact, both are closely related. In numerical characters we find variants deviating from the average value in positive and in negative directions. Since all processes in nature depend upon causes, we are obliged to assume causes of variation with either positive or negative effects, of which causes neither the number nor the intensity of effect is known. These causes must be different from those which determine the average character of the form-unit, and at the same time must be weaker in effect than the latter. Now each individual has its own fate, which word includes the total sum of enormously numerous and minute factors acting on it in the most diverse combinations, which naturally cannot be identical either for all individuals of the form-unit or in every moment of the existence of the single individual. Thus we get the conception of an enormous number of elementary causes of variation, which may be regarded as equally effective so far as their small power goes. Of these one set can effect positive deviations, the other negative deviations from the average values of the different characters, all being able to act on each individual of the form-unit, though as a matter of fact they do not all act on it. The active set of causes is in each case any random combination of positively and negatively acting causes, and each of these combinations has a higher or lower degree of probability, according to which its effect is more or less frequent in the total population of individuals. The sum total of positively acting causes may be equal in number to that of negatively acting ones, or be different from it.

Starting from such assumptions, mathematicians have investigated

the series of variation of numerical characters, and have found that the actual magnitude of the frequencies of variants corresponds to the law of probability of combinations, which law Pearson [12] has recently expressed by his *general probability curve* (*curve of variation*). This is, as far as I know, the first substantiated mathematical law of biological processes. So in investigating a series of variations we have next to find the probability curve determining the shape of its polygon of variation. But this demands a consideration of the already somewhat compendious mathematical literature of the subject, which I cannot now discuss. Pearson's methods I have recently described in a manner especially suited to the needs of biologists [7].

Curves of variation are symmetrical if the two groups of causes of variation are equal in number; asymmetrical, if the latter are unequal; in the single form-unit they always show one summit. In symmetrical curves the maximal ordinate and the centroid vertical are identical; in asymmetrical curves their distance apart is greater the more asymmetrical the curve. The ratio between this distance and the index of variability gives an abstract number, the *index of asymmetry* of the curve (A), which is, corresponding to the position of the centroid vertical to the maximal ordinate, either positive or negative. Positive asymmetry of a curve means that there are more negative than positive causes of variation, while negative asymmetry implies the contrary.

The question as to the variation of a numerical character within a form-unit is therefore to be answered by giving the average value, the indices of variability and of asymmetry, and the formula of the curve of variation of this character. These four data given, the series of variation can always be reconstructed with only a small error, which decreases as the number of investigated individuals is increased.[1] The first three data of our example (*Palaemonetes*) are:—

$$M = 4\cdot3137,\ \epsilon = \cdot8627,\ = A - \cdot1735;$$

the curve itself is a curve of type iv. (Pearson [12]) of the form

$$y = y_0(\cos\theta)^{2m} \frac{-}{l} {}^{\tau\theta}$$

where y_0, m, and τ are constants, $\theta = f(x)$ the variable. The error between the empirical and the theoretical series of variation amounts to only $\cdot3\%$ of the total number of individuals, viz.:—

Variants .	0	1	2	3	4	5	6	7	rostral teeth).
Emp. frequency .	0	2	18	123	372	349	50	1	(individuals).
Theor. frequency (y)	·1	1·7	18·3	122·2	374·6	345·9	51·7	·5	

From the curve of variation the probable range of variation of the

[1] The magnitude of the error is, *ceteris paribus*, inversely proportional to the square root of the number of investigated individuals.

character may be deduced for any assumed number of individuals; since a curve of variation is a curve of probability, the range depends really upon this number; for instance, a variant of the probability $\frac{1}{10000}$ is hardly to be expected among only 100 individuals. On the contrary, if we find with an otherwise harmonious curve of variation some single extreme variant empirically more abundant than it ought to be according to its probability, we may conclude that this variant did not arise by normal variation, or at least not exclusively by it, but that it has been produced by pathological conditions. This conclusion is to be controlled by determination of the correlation-coefficients which we shall discuss later on. Thus my attention was directed to the hitherto apparently unknown ability of Syngnathidae which have lost the posterior segments of the body, to regenerate not only a complete caudal fin, but probably also a urostyle. I shall refer elsewhere to these observations and to some experiments confirming them.

Comparing several form-units of the same, or of different species, as to a single numerical character, all possible differences of the latter must clearly be recognised in the differences of its four statistical data. Having investigated all the form-units of a species in respect to a single character, we should find by graphically representing the results a system of curves of variation partly overlapping, of which the centroid verticals would be more or less distant from each other, while the indices of variability would be nearly constant. One set of the form-units represents the constitutional differences of the species due to sex and degree of development, the others correspond to differences in the external conditions. If the latter conditions have influenced not only one character but several characters at once, the species has been split up into races or varieties.

Up to this point we have dealt only with variation of a single character within the form-unit. But since all the characters vary, we must investigate whether they vary independently of each other, or whether there is possibly any relation between the variations of different characters. Here also we have recourse to calculating probabilities. Every one knows that the probability of the coincidence of several events independent of each other equals the product of the probabilities of each single event. From each deviation from this condition within a larger series of observations we may conclude the existence of some causal relation between the events, that is in our case between the individually combined variants. This causal relation can be a direct one, if the variants of one character are causes of the other (correlation *sensu stricto*) or an indirect one, if both characters depend upon the same causes of variation (symplasy). Thus, by simply comparing the real with the probable frequencies of the individual combinations of the variants of two characters within a larger number of individuals of the same form-unit, we are always

able to find out whether there is *correlation* between these characters or not.

For numerical characters there are now simple methods (Galton, Pearson) of calculating the *degree* of deviation of the real frequencies of the combinations of their variants from the probable ones. The results of these calculations are abstract numbers between zero (no deviation from probability) and one; the latter signifies the highest possible degree of deviation of the combination-frequencies from probability, inasmuch as each variant of the one character occurs only combined with a definite single variant of the other. These abstract numbers we call the *coefficients of correlation* of the investigated pairs of characters. The most convenient coefficient of correlation is that calculated according to Pearson's method [13], and determined as the mean product of the individually combined relative deviations of the two characters from their average values, while the relative deviations are the absolute ones expressed in terms of their indices of variability. Like the indices of variability of homologous characters, the coefficients of correlation of homologous pairs of characters show a certain constancy even in different species (Warren [17]). This, again, I believe to be an expression of physiological relations between the correlated organs with regard to the respective characters.

If on the average the combined variants lie either, on the one hand, both above or both below the mean values of the two characters, or, on the other hand, if the one is a positive, the other a negative deviation from these values, we get either a positive or a negative coefficient of correlation, and accordingly deal with positive or negative correlation. Series of variation between which there is positive correlation tend to form constant differences of the individually combined variants, while those between which there is negative correlation tend to form constant sums of the variants. The constancy of these sums or differences is the more remarkable, the higher the coefficient of correlation. The constancy of the sums of variants, that is, negative correlation, is mostly to be found in metamerically disposed characters (homoiotic variation), that of the differences of variants, that is, positive correlation, in antimerically disposed characters, especially in those with symmetrical variation.

As it is possible to investigate the probability or the degree of correlation of the frequencies of the individual combinations of the variants of two or more characters, so it is reciprocally possible to treat the combinations of variants of one and the same character in two or more individuals which are connected by known relations in a similar manner. This might be, for instance, when we wish to decide if a character is important in sexual selection; or again, if a character is hereditary or not. In the former case the combination of variants, effected by mating, of one and the same character in males and females, must show correlation; in the latter the same is true for parent and

offspring. Galton and Pearson have shown this in anthropological instances, but in zoology almost nothing has been as yet done.[1]

Statistical investigations may be applied to all sorts of characters; the immediate results acquaint us with the relative frequency of the variants, and show, in addition, whether their variation depends upon that of other characters or not. If we have to deal with numerical characters, we discover furthermore the particular law according to which their variants are distributed in the existing individuals of the form-unit, and the coefficient of correlation according to which the variants of several characters are individually combined. From the mathematical analysis of series of variation we discover constitutional factors, and the known external conditions of life differentiating the species into form-units and their higher groups, which are characterised in the first place by the mean values of their characters. Within the form-unit numerous other causes of variation, which are not known, produce by their combinations the individual differences of the characters in typical proportions of frequency. According to their physiological conditions the organs of different species react more or less markedly to the causes of variation of their characters, so that the physiological plasticity of the organs is indicated by the indices of variability of their characters.

The idea of investigating complexes of individuals statistically, in order to discover series of variation, is not new. In ichthyology especially, where nearly all systematic characters are dimensional or numerical, as early as 1857 A. Czernay [5] published observations on the variation of specific characters in freshwater fishes from the vicinity of Charkow. From the period 1870-1880 Heincke's [10] papers on the varieties of the herring may be named. All older publications, however, deal with such a small amount of material, that the data are without value for the mathematical analysis of series of variation.

In 1890, in the *Proceedings of the Royal Society of London*, there was published the first zoological paper where the results of statistical observations of numerical characters were mathematically analysed. W. F. R. Weldon [19] on the suggestion of F. Galton investigated four dimensions of *Crangon vulgaris* in numerous individuals from three different localities, and found that their variation follows the Gauss' law of error, which is a frequently occurring special case of Pearson's general probability-curve, and that each of the characters had a different mean value in the different localities. Two years later, using Galton's method, Weldon [21] showed the correlation between several characters of *Crangon*. Then he made a series of investigations on variation and correlation in *Carcinus maenas*, treating differ-

[1] Since the above was written, Warren [18] has published an interesting paper on heredity in *Daphnia*.

ences of age, sex, locality, in certain dimensions, and partly explaining them by selective processes [22, 23]. Further, he found a dimorphism of the females in the Naples race, which Giard [9] tried to explain by parasitic influences. In the meantime Thompson and Warren, inspired by Weldon, worked on variation and correlation in the dimensions of *Palaemon serratus* [15], *Carcinus maenas* [16], and *Portunus depurator* [17]. Warren first discovered the fact, afterwards several times confirmed, that the coefficients of correlation of homologous characters remain fairly constant not only within the form-units of the same, but also within those of allied but different species. Warren also was the first zoologist to follow Pearson's improved method in analysing series statistically. Thompson demonstrated distinctly determined changes of mean value and index of variability in the characters of the same form-unit in different years, which result Weldon has investigated further, and has recently [24] considered as a proof of the reality of natural selection.

While the leader of the English biological-statistical school is especially interested in the problem of natural selection, the North American school, led by C. B. Davenport, works especially on morphological problems. First, Davenport in association with Bullard [6] investigated in a very rich material (4000 individuals) the influence of sex on the constants of variation and correlation. On Davenport's suggestion Brewster [1] and Field [8], the first in mammals, the second in insects, investigated the relation between the variability of certain characters and their systematic importance. The result tended to show that the two correspond. But the material basis of these investigations appears to me too small to settle this question definitely.

Besides mathematical-statistical researches there have been published, since statistical methods came into vogue, some others of a non-analytical sort based upon large numbers of individuals. Among these I wish to call especial attention to Bumpus' papers on variation and mutation in two very different species introduced from Europe to North America, the sparrow (*Passer*) [2], and the periwinkle (*Littorina*) [3]. In each of these instances the great increase of variability in the American forms, compared with the European ones, is remarkable.

In Germany Heincke and I are still alone among zoologists in applying statistical methods to problems of variation. Heincke is chiefly interested in the existence of local races within the species, and one of his most important results is, I think, his method of determining the racial character of any given individual as well as its specific character [11]. Among botanists the number of fellow-workers increases every year. Besides foreign naturalists, H. de Vries and G. Verschaeffelt, who have published German papers, F. Ludwig has for several years been statistically investigating the law of Fibonacci in plants, while recently H. Voechting has published a splendid paper on abnormalities of flowers. There is a great advantage in botanical

objects, because they can easily be experimented on in regard to heredity and local variation.

If I have succeeded in showing the statistical method of investigating variation to be based on logical foundations, and to be capable, by its special nature, of yielding new and valuable results which cannot be acquired by any other method of investigation, it may lead, I hope, to the increased use of the method by zoologists. The mathematical training its application requires, does not exceed the standard of final high-school examinations. The exact and unambiguous results of the analytical method have a charm of their own, and it ought not to be forgotten that a precise terminology helps in every scientific work. The merely statistical research, whether directed towards aetiological or towards morphological problems, is only, I believe, the introduction to a more important kind of work, by which statistical-analytical and therefore critical results will be established with the help of quantitative experiments. To carry out this purpose we would need a separate institute, distinguished from the ordinary biological laboratory by larger accommodation for breeding experiments, and from the taxonomic museum by facilities for storing in an accessible fashion large quantities of homogeneous individuals which may readily be investigated at any time either for controlling or for completing former researches. To the eminently practical value of such an institution for agriculture, forestry, horticulture, as well as for fishery and cattle-breeding, I can now only refer; its chief aim of course would be scientific investigation, of which the results are always either directly or indirectly valuable to practical life. The first step, however, is that the statistical-analytical method be duly recognised as a new and important organon in the advancement of biology.

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18 HOFWEG, HAMBURG.

The Cereal Rust Problem—Does Eriksson's Mycoplasma exist in Nature?

By GEO. MASSEE, F.L.S.

THE idea that the vegetative condition of parasitic fungi exists in the tissues of certain host-plants, and is transmitted from one generation to another, is not new. Berkeley (1), in discussing the subject, states as follows :—" The mycelium of the cereal fungi is known to exist from the earliest period in corn, and is perfected only under favourable conditions." Worthington G. Smith (2), in dealing with wheat rust, says: "They all prove that Puccinia is hereditary; that it exists in a finely attenuated state in seeds from diseased plants, and can be transmitted in a long interminable line from generation to generation." (3), "We, as well as many other observers, have shown that seeds apparently sound, will often, on germination, show disease in their seed-leaves; such plants are saturated with the germs of disease from their earliest period of growth." (4), Writing on the supposed hereditary nature of a disease affecting species of *Dianthus*, the same author states: "This case has a distinct bearing on the allied fungus of corn mildew, *Puccinia graminis*, which no one doubts is carried on from one generation to another in the seeds. This being the case, and nearly every grain of corn being probably saturated with the poisonous plasma of corn mildew, the statements regarding the production of mildew on corn from the contact of spores from a Barberry bush—the corn, it must be remembered, being almost invariably infested with hereditary disease —should be received with very great caution."

The above statements are not supported by experiments, but advanced as the only apparently possible explanation of the repeated occurrence of disease in those cases where external means of inoculation were not evident.

Quite recently Professor Jakob Eriksson (5), Director of the Experiment Station of the Royal Swedish Academy of Agriculture, has propounded a theory similar in substance to the ideas expressed by Berkeley and Smith, and bearing on the subject of rusts attacking cereals. The following quotations indicate the leading idea of the theory :—

"Plants of a variety of barley extremely liable to yellow-rust, which have been grown in sterilised soil in isolated glass houses, and have been protected against infection from outside, have sometimes become affected by yellow-rust."

"The yellow-rust appears in certain varieties of wheat and barley that are especially susceptible, uniformly four to five weeks after sowing."

"The results of these experiments prove beyond doubt that the disease must have come from an internal source, and have been inherited from the present plant."

"The fungus lives for a long time a latent symbiotic life as a mycoplasma within the cells of the embryo of the cereal plant, and only enters upon a visible stage in the form of a mycelium a short time before the pustules break out, and then only if the conditions are favourable."

Eriksson was gradually led to adopt the idea expressed above after prolonged study upon the succession of rust on cereals, a detailed account of which is to be found in another book by the same author (6); also in considering that the various forms of spores or reproductive bodies would not account for the amount of rust produced. The conclusions arrived at on this last point are summarised by the author as follows:—

"The germinating power of the uredo and aecidiospores is often small, or at best capricious."

"The germinating power of the winter-spores (teleutospores) depends upon certain external conditions, and is restricted to a short period of time" (5).

Now, if this theory proves to be true—that is, if it can be demonstrated that the protoplasm of a parasitic fungus can blend with the protoplasm of its host-plant, and remain passive in this condition from generation to generation until conditions are favourable for its manifestation in its own proper form as a parasite on the plant, in the protoplasm of which it has for a certain period of time remained inert—many unsolved problems in Vegetable Pathology would be easily explained, or, at all events, the discovery would afford a very feasible explanation of phenomena at present inexplicable. If this theory had been evolved some few years ago, it would undoubtedly have explained in a satisfactory manner the occurrence of the common "smut" of oats (*Ustilago avenae*, Jensen). An old idea was that the oat plant was inoculated by "smut" spores when in bloom, the fungus afterwards developing in the ovary. This idea being disproved, the mycoplasma theory would have been useful; now, however, that Brefeld's amply corroborated explanation of the life-history of "smut" has appeared, the necessity of mycoplasmic intervention has been superseded. The same will probably prove true in other instances. The weak point in the mycoplasma theory appears to be that it proves too much.

That Eriksson himself can only support his theory on negative evidence is shown by his own candid remark as follows (5):—"These results [those given above] prove beyond doubt that the disease must come from internal germs inherited from the parent plant. But in what form are these internal germs of disease living? Is it easy to follow and identify them with the microscope? Not at all. They can only be detected just before the breaking out of the young pustules."

A theory propounded by one who has for many years made a special study of the "rust" problem has naturally attracted much attention, and Eriksson's experiments have been repeated by observers in different countries, the result being in every instance opposed to the theory.

Bolley (7) holds that there is no ground for the mycoplasmic theory, his reasons for so doing being founded on similar experiments to those on which Eriksson founded his theory. Cereals were grown until quite mature, in structures specially arranged to prevent inoculation from rust spores, with the result that the plants remained perfectly free from disease, whereas every specimen of unprotected plants of the same kind growing close to the protected plants were badly rusted.

Mr. G. Nicholson, F.L.S., curator, Royal Gardens, Kew, kindly procured for me one pound of "Horsford Pearl" winter wheat. This variety was selected, because Eriksson says (5):—"We are warranted in suggesting that the predisposition of the Horsford wheat to yellow rust may be explained by assuming that between this variety of wheat and the yellow rust an extremely vital mycoplasma-symbiosis is to be found."

This was experimented with as follows:—

Half the quantity was used the first season. Two flower-pots, one containing ordinary Kew soil, the other old stable manure mixed with a very small quantity of soil similar to that used in the first pot, were prepared; no sterilisation was attempted in either case. An equal weight of wheat was soon in each pot. Each pot was placed on a large plate, a thick layer of cotton-wool was placed round the edge of each plate, and on this layer of cotton-wool a tall glass globe rested, each globe having an opening at the top plugged with cotton-wool. The glass globes were not removed for a period of twelve weeks, the necessary water being supplied by wetting the cotton-wool outside the bottom of the glass globe. At the expiration of twelve weeks the wheat in both pots had grown to the top of the glass globes, and in both pots was found to be perfectly free from "rust." At this stage these experiments terminated.

The remainder of the half-pound of wheat not sown in the plant pots was sown in a mixture of rotten manure and soil placed in a shady corner out of doors. At the expiration of nine weeks pustules of "rust" appeared on some of the leaves, and when the plants were about two feet in length nineteen per cent of the plants bore rust pustules on the leaves; but this "rust" on examination proved to be

black rust—*Puccinia graminis.* No trace of yellow rust—*Puccinia glumarum*—was present.

The following season the remaining half-pound of wheat was sown under conditions precisely similar to those described above. The plants protected by glass globes remained perfectly free from rust of any kind, whereas the seed sown on manure, and fully exposed to atmospheric conditions, showed at the expiration of thirteen weeks, twenty-eight per cent of rusted plants; the rust being *Puccinia graminis.* Not a trace of yellow rust—*Puccinia glumarum* — was present.

Remembering the clause in Eriksson's theory that the mycoplasma only assumes a visible form "if the conditions are favourable," I am ready to admit that both my out-door and other experiments with "Horsford Pearl" were not grown under the conditions necessary for the conversion of mycoplasma into mycelium, nevertheless my experiments are not unique in this respect.

McAlpine of Melbourne records having received from Eriksson ten varieties of wheat showing in a marked degree powers of resistance to yellow rust—*Puccinia glumarum.* When sown in Australia all the varieties were attacked by one or other of the native rusts—*Puccinia dispersa*, or *P. graminis.* No trace of yellow rust—*P. glumarum*—was observed (8).

These experiments corroborate at least what has previously been stated (9), that cereals especially susceptible to one form of rust in a particular country, may, if sown in another country, lose their susceptibility for the original kind of rust, and prove equally susceptible to another form.

As to whether this also proves that mycoplasma does not in reality exist, or that a change of locality destroys a mycoplasma that previously existed, I am not at present prepared to say.

Another set of experiments with wheat, commenced before the mycoplasma theory was published, were conducted for the purpose of endeavouring to ascertain whether mycelium passed into the seed in those cases where the mycelium of a parasitic fungus was undoubtedly present in the fruit.

This line of research was suggested by a remark made by Collenette (10), who in writing on the Tomato disease in Guernsey, says:—"My theory, then, is that the 'sleeping' disease is really primarily propagated by the seed, and the first thing to be done is to refuse to save or use the seed derived from the diseased plants." Collenette's theory was founded on the discovery of delicate hyphae in the tissue of tomato seed produced by a diseased tomato. I also had an opportunity of examining some seed obtained from a diseased tomato, kindly furnished by Mr. Collenette, and succeeded in detecting slender, hyaline hyphae about 2μ thick in the testa of the seed, but at the time was not able to demonstrate that these hyphae were genetically connected with

Fusarium lycopersici, Sacc., the fungus causing the tomato disease. This discovery was announced in a footnote to Collenette's paper quoted above. During further experiments with seed from diseased tomatoes sent by Collenette, I was able to corroborate the presence of slender hyphae in the testa of the seed, and furthermore obtained both the *Diplocladium* and *Fusarium* stages of the fungus by placing sections of the diseased seeds in a culture medium.

The above experiment leaves no doubt as to the fact of seed produced by a diseased tomato fruit being able to perpetuate the disease, due to the presence of latent mycelium—not mycoplasma—in the testa of the seed.

Experiments with Hollyhock seeds gave similar results. When the carpels are attacked by the Hollyhock rust—*Puccinia malvacearum*, Mont.—the testa of the seeds frequently contain mycelium, and such seed when sown, if it germinates at all, gives origin to a large percentage of diseased seedlings, the teleutospores of the fungus appearing on the hypocotyl and on the cotyledons in abundance. This experiment is of considerable importance, as the fungus belongs to the same genus as those producing rust on cereals.

Ustilago vaillantii, Tul., a fungus infesting the anthers, and sometimes also the ovary, of *Scilla bifolia*, and other allied plants, has been under constant observation for the past six years with the object of ascertaining its complete life-history, which is intended for publication in detail in the near future. The leading points in its history bearing on the question at issue are as follows:—Quite young seedlings may be infected by spores present in the soil. A perennial mycelium is formed in the short stem at the base of the bulb; from this hybernating mycelium hyphae pass into the flower-stalk each season; this mycelium finally reaches the anthers and the ovary. The mycelium is only present in the tissues at any given time for a length of about 2 mm.—in other words, as the mycelium creeps up the tissues of the flower-stalk it deliquesces and disappears behind, the growing tips of the mycelial strands only being at any one time evident, and when it has passed into the anthers there is not a vestige of mycelium to be found in the filaments of the anthers. All this takes place while the flower is in the bud condition, and the whole inflorescence is yet underground. When the fruit is attacked all the seeds are often completely destroyed, their position being occupied by a powdery black mass of fungus spores. In other instances only some of the seeds are destroyed, others present in the same fruit remaining apparently healthy; but on microscopic examination of such seeds slender mycelium can often be detected in the testa. Apparently healthy seeds obtained from a fruit having some of its seeds destroyed by the fungus, when sown in sterilised soil, and freed from adhering fungus spores by proper methods, always yield a large percentage of diseased seedlings, the mycelium soon being quite conspicuous in the delicate

stem before the bulb begins to form. This infection I consider to be due to the mycelium present in the testa of the seed. Unfortunately complete proof of this is not forthcoming as it was in the tomato disease described above, as up to the present moment no one has succeeded in causing any member of the Uredineae or Ustilagineae to produce fruit as a pure culture, or apart from the natural substratum.

In many instances the mycelium passes up the flower-stalk and enters the anthers and ovary without however producing spores, this final act being prevented by conditions at present unexplained. Mycelium can be frequently observed in the testa of seeds produced by such plants, and if the seeds are sown under conditions preventing external inoculation many diseased plants result.

Plants attacked in this manner can be easily recognised after a little experience, owing to the deep blue-green colour of the flower-stalk.

Returning to the experiment with wheat. Distinctly shrivelled grain caused by the presence of the rust called *Puccinia glumarum*, Eriks. and Henn., better known in this country as *Puccinia rubigo-vera*, DC., developed on the chaff, and sometimes also on the grain itself, was used. Forty grains were sown in each of two pots, one containing ordinary soil, the other rich stable manure with a small admixture of soil. Each pot was protected by a glass vessel with cotton-wool, as in the experiments described above. In the pot containing ordinary soil sixty per cent of the grain germinated, whereas in the richly manured pot only fifty-two per cent germinated. When the plants were three inches high indications of rust pustules were seen on a few leaves in each pot, and when the plants were five inches high twenty-six per cent of the plants were rusted in the pot containing ordinary soil, and forty-seven per cent in the richly manured pot. At this stage the experiments terminated, as the spores were in some instances mature, and the plants being crowded inoculation from spores would probably have taken place, and thus a greater percentage of rusted plants would have resulted than those due to what I consider as cases of rusting from the use of diseased seed. As a control experiment a similar number of plump and healthy grains obtained from plants having the foliage badly rusted, but the ears perfectly free from rust, were sown in ordinary soil and protected as described above. Ninety-six per cent germinated, and all the plants remained perfectly free from rust.

Another experiment was conducted as follows:—A jar was filled with sterilised water containing a small amount of extract of manure; a piece of coarse muslin was stretched over the top of the jar just in contact with the liquid. Twenty grains of wheat obtained from a plant not attacked by rust and presumably healthy were placed on the muslin, the jar being protected by a glass globe. Nine of the grains produced vigorous plants, the remainder being weakly were removed. When the plants were about two inches high a sterilised piece of

cotton-wool was loosely twisted round the base of each of three plants, extending up the plant about half an inch from the muslin on which the plants were growing. Three circles of stout white sterilised blotting-paper, each with a small hole in the centre and a slit from the hole to the margin, were prepared. One of these blotting-paper collars was placed round the stem of each of the wheat plantlets already enveloped at the base with cotton-wool, on which the blotting-paper rested, and was kept moist by the water conducted by the wool. Fresh uredo-spores of *Puccinia glumarum* were deposited in abundance, by means of a scalpel, on the damp blotting-paper at a distance of about one line from the stem of one of the plants; at a distance of about three lines from the stem in the second example, and in a circle about four lines from the stem in the third experiment.

Within a week of depositing the spores on the blotting-paper, the plant to which the spores were placed nearest drooped and fell over as in the disease known popularly as "damping off." Microscopic examination showed that death was due to a dense weft of mycelium emanating from the germinating uredo-spores that had surrounded the stem of the plant. I could not, however, demonstrate satisfactorily that any of the hyphae had penetrated the tissues of the wheat plant.

Within eighteen and twenty-two days respectively from the date of placing the spores on the blotting-paper, the two remaining plants showed uredo-pustules on the upper surface of the lowest leaf; in both instances the pustules appeared at a point about one inch above the blotting-paper. This, however, I do not hold to prove that the mycelium travelled upwards for that distance in the tissues of the leaf, but rather consider that the leaf increased an inch in length between the period of inoculation and the time the pustules first became visible externally. The remaining plants not inoculated remained free from disease.

The above experiment proves satisfactorily, I think, one point, namely, that it is not necessary that the uredo-spore should be in actual contact with the host-plant to insure inoculation, but that the germ-tube can live for some time as a saprophyte, when, if conditions are favourable, it can enter the tissues of a host-plant and assume parasitic functions. This feature may prove to be of great importance from the practical point of view in combating the disease. During the present season I hope to conduct further experiments for the purpose of ascertaining for how long a period the mycelium can grow as a saprophyte without losing its power of inoculating a host-plant, and also what distance it can traverse before effecting the same.

During the present spring an experiment was conducted on similar lines to the above, only teleutospores were used instead of uredo-spores. In this instance only one out of three infected plants produced uredo pustules, whereas an uninfected or check plant also showed

pustules, therefore no comment is necessary; only further experiments in the same direction will be made in the future.

Tradition acts as a powerful bias, even in scientific matters; immediately following De Bary's brilliant discovery of heteroecism, the condition of rust on the Barberry alternating with that on some graminaceous plant was considered indispensable for the continuation of the species; eventually it was discovered that the stage on Barberry could be dispensed with, and yet the rust appeared as rampant as ever; in fact in Australia, where rust is more abundant and injurious than in Europe, the aecidium condition is unknown; in India also, where ruts is very destructive, no aecidium condition is known to exist within hundreds of miles of the wheat-growing districts. At the present day it is generally accepted that the uredo-spores only retain their power of germination for a very limited period, and that the uredo-spores must be in contact with the host-plant to effect inoculation. The experiment just recorded modifies this idea to some extent. Teleuto-spores, again, are considered at present as being only able to infect the host that bears the aecidium stage; however, their production in such immense numbers in those countries where no aecidium stage is produced, or required, suggests that they may possibly play some part in the reproduction of the fungus hitherto undiscovered.

Numerous preparations of rust-shrivelled grains of wheat have been examined microscopically, and an abundance of mycelium detected in the outer layers of the grain, correctly speaking, in the pericarp; but not in a single instance have I been able to detect mycelium in the embryo; and in those cases where the grains were allowed to germinate and form a tiny plantlet up to half an inch in length, the mycelium never appeared to pass into this part. On the other hand, when sections of diseased wheat were placed in culture media, hyphae frequently radiated from the section on all sides for some distance.

May not similar hyphae radiate in the soil from diseased grain when sown under natural conditions, vegetate for some time in a saprophytic manner, and finally, if conditions are favourable, infect the young plantlet at, or just below, the ground level? Sufficient of obviously rust-shrivelled grain is frequently used as seed; and if, in addition, plants are infested with mycelium, which for some at present unknown reason does not produce spores, as I have shown to be the case with *Scilla bifolia*, and also recorded by Bolley (11) as frequently occurring in the case of wheat attacked by *Tilletia levis*, Kühn; and assuming that this mycelium also passes into the grain, then we should be able to account for a considerable quantity of the rust prevalent, without introducing a new factor—mycoplasma—into the theory.

Mycelium of the rust fungus has been observed in the grain of wheat by Eriksson, as shown by the following quotation (12), and if inoculation of the young plant is effected by means of mycelium originating from the grain, and growing for a longer or shorter period

in the soil previous to such inoculation, as explained above, then Eriksson's difficulty in accepting the presence of such mycelium as the cause of the disease, on account of its absence from the embryo, both before and immediately after germination, is removed.

"Ce fut en vain que je cherchai à constater, par le microscope, la présence de germes infectieux internes. Certainement je découvris dans les tissus périphériques des graines du froment ridées et déformées par la rouille, un mycélium très développé, et même parfois des espèces de nids des spores d'hiver (*teleutosporae*). Mais toutes les tentatives faites pour trouver un mycélium dans le germe lui-même, que ce fût dans le germe renfermé encore dans la graine, ou dans le germe sortant de la graine à la germination, restèrent infructueuses."

Many people have become so thoroughly accustomed to the annual loss of a certain amount of capital through "rust," "bunt," and "smut" of cereals, that it is looked upon as a matter of course; or, in other words, such loss is not realised at all; and it is only during seasons when these diseases are rampant that their presence is forced upon the cultivator, and even then only the amount of loss above the usual annual average is realised. The following figures, taken from official sources, illustrating the amount of loss sustained during an ordinary season, should be sufficient to explain why some governments have considered it incumbent upon them to aid in the endeavour to prevent such enormous losses.

"Oat smut (*Ustilago avenae*) alone destroys each year in the United States over $18,000,000 worth of grain. The other grains, especially wheat, rye, and barley, also suffer severely from smut diseases; the amount, however, has not been overestimated" (13).

In the same country we learn that "The aggregate loss from 'rusts' (*Puccinia* sp.) is estimated to be over $40,000,000 annually" (14).

The Prussian Statistics-Bureau states that the loss caused by "rust" alone on wheat, rye, and oats, in Prussia, during the season of 1891, amounted to a little over £20,000,000 (15.)

In Australia the loss in the wheat harvest of 1890-91, due to "rust," has been estimated at £2,500,000.

Finally we learn that in the United States, "Probably it would not be overstating the loss from plant diseases, as a whole in this country, to place it at $150,000,000 to $200,000,000 annually" (16).

The amount of annual loss in Great Britain arising from plant and animal pests is not officially estimated, but it may safely be assumed that, if half the amount of loss could be prevented, farming and horticulture would prove to be remunerative occupations.

An equally formidable array of figures could be quoted from official publications showing the actual gain derived by following the directions issued from experiment stations.

The question that naturally suggests itself at this point is the

following:—How is it to be explained that in countries where experiment stations are most numerous, and information on every question to be obtained without delay, that the annual loss arising from those identical causes which it is the avowed object of such institutions to assist in preventing, is still so great? The answer is, officials of experiment stations can give valuable information, but—except in the case of certain diseases, and then only in limited areas—cannot enforce the carrying out of the necessary measures for their prevention.

The first and greatest difficulty that those who essay to teach cultivators of the soil how to avoid loss from the attacks of plant and animal parasites, have to contend with is, that of replacing prejudice by intelligence; and this is perhaps more especially true of old countries, where you are confronted by statements showing how somebody's great-grandfather made a fortune out of farming without having recourse to any of the methods now advocated.

Tact is undoubtedly necessary, but actual demonstration is the sheet-anchor of success; consequently, as has been realised in many countries, experiment stations are indispensable, where actual results can be seen. Literature, as a supplementary factor, is of undoubted value, but too much reliance should not be placed on this feature during the initial stage of conversion.

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The Herbarium,
Royal Gardens, Kew.

Problem of Honeycomb.

By CHARLES DAWSON, F.G.S., and S. A. WOODHEAD, B.Sc., F.C.S.

THE hexagonal arrangement of the cells of honeycomb has been generally ascribed to a structural instinct on the part of the bees; the object of this paper is now to show that the form of the bee-cell is chiefly influenced by a "crystalline" hexagonal formation due to the cooling of the wax.

While experimenting with waxes and resins one of us (Mr. Dawson) noticed that on cooling the mixture had a tendency to arrange itself in hexagonal forms, from which he surmised that the outline of bee-cells might be primarily due to the natural structure produced in cooling wax. At the instance of Mr. Woodhead, who also recognised the analytical importance of such a discovery, it was agreed to work out the details together in Mr. Woodhead's laboratory at the Agricultural College, Uckfield.

It was first of all determined that although the addition to beeswax of resinous substances gave a more pronounced and bolder outline to the hexagons, no such addition to beeswax was necessary for their production.

If a thin slab of beeswax be melted in a shallow tray (measuring, say, 10 × 8 inches), which is evenly heated throughout, and is then placed to cool gradually in a warm atmosphere without draught, hexagonal crystalline forms, of the ordinary size of a worker-cell of the hive-bee, will be seen gradually forming at the bottom of the dish. And a similar line of hexagons will be seen to form on the surface of the wax round the sides of the dish where the wax first cools. The sides of the hexagons are to be seen forming and branching out in advance of the cooling wax, and when a portion of the wax in the centre of the dish alone remains melted, the remaining hexagons form very rapidly and almost appear to flash out upon the surface.

The tray should be exactly level and the wax about 1·5 mm. thick and of uniform depth, and the atmosphere of even temperature (say a few degrees below the melting-point of the wax), otherwise the hexagons will be irregular in size and shape.

It is immaterial how thin the plate of wax is, as the hexagons are

formed in any case, but their size is undoubtedly regulated by the thickness of the plate of wax, the rule being the thinner the plate the more minute the individual hexagon. The same result may be obtained on a much smaller scale so as to produce only one or two hexagonal forms, but the operator will then find that the difficulty lies in the rapid cooling at the sides of so small a mass of wax.

The explanation of the formation of these hexagonal bodies is as follows:—

On cooling, the wax at first forms into nuclei of nearly equal size. On the shrinking of the wax by further cooling, these nuclei or spheroids are pressed together, forming planes at their points of contact. Should the wax be rapidly chilled before these spheroidal bodies are formed to their full extent, they are then prevented from coming into contact one with another by the intervening nebulous masses of "uncentralised" particles of wax. It would appear by microscopic examination that these particles are also smaller nuclei which become absorbed in the larger. They also, like the larger, assume hexagonal form. In this state the nuclei appear when cold as solid circular bodies.

The hexagons appear very distinctly above and below the surface while the wax is cooling. When it is actually solid, their forms are often very indistinctly seen, or may be altogether invisible, but they are none the less present. The bases of these hexagons, which lie mid-way between those visible at the top and those at the bottom, are pointed and are arranged so that the point of the base of the upper hexagon coincides with the points of contact of the lower hexagons as in the honeycomb. These bases can be observed by making a very thin microscopic section, but several hundred sections had to be examined before they were made out with certainty.

When a small amount of resin and turpentine is added to bees-wax and melted, and the mixture is allowed to get cold, the outlines of the planes of contact on the hexagons are more distinct and are to be seen raised upon the surface. Under these circumstances they may be easily rubbed with black lead, which still further increases their visibility.

Our chief experiment was next to put our theory to a practical test, and observe in what manner the bees would deal with a cast sheet of pure beeswax, which, when viewed by a side light, distinctly showed traces of these natural hexagons over its surface.

Before introducing it to the bees, we had traced upon it with vermilion a group of the hexagons which appeared near the centre of the plate. (Another group we black-leaded.) This was then photographed, after which the wax plate was placed in an observatory-hive on a bar-frame. The bees soon started upon it, proceeding to excavate round hollows in the centres of the hexagons, at the edges of the plate, pushing out on all sides the *débris* around the edge of each

excavation. When they reached the planes of contact of the hexagons, either on feeling the minutely raised edges on the surface, or more probably on feeling the increased density of the wax, the bees determined the limits of their excavation; and it was then discovered by us that the bases of these hexagons were three-sided in the usual form of a bee-cell. There are two reasons for the density of the wax, namely, the outer edges of the nebulæ are composed of smaller particles and are therefore more compact, also the pressure brought to bear on the planes of contact renders the sides of the bodies still more compact. Meanwhile, a similar process was going on in the cells which lay as nearly as possible in the same irregular wavy line, but the work on one side of the sheet was sometimes considerably more advanced than on the other, the excavation being brought three or four more rows of cells nearer the centre on one side than on the other.

Portions of the *débris* taken from the centre of the hexagon were now kneaded up by the bees into a kind of froth, and placed above the lines of pressure or margins of the hexagons, the residue of the *débris* being put aside for future use.

The portions placed on the margin of the hexagons speedily adhered and solidified, another layer was then added by the bees, and this process was repeated, thus forming a series of strata (which may be noticed under a magnifying glass on the sides of the complete cells); the bees planing and polishing the inner surfaces of the cell upwards from the base, taking as guides the planes and angles of the hexagons.

In the places where we had traced the outlines of the hexagons in vermilion, the bases of the cells were to be distinctly seen formed upon the vermilion outlines.[1] Similar experiments have been repeatedly tried with the same results.

In places where the wax plate had been of uneven depth, or had cooled too rapidly, the comb presented an irregular appearance following in form the irregular "crystalline" bases beneath, the result being very distinctive and striking to the practised eye of an apiarist.

When in a natural state, the newly secreted wax is formed into a small pendent plate, it is probable that the bees crowding around produce the required amount of heat to soften or to keep soft the newly deposited wax, and allow it to cool very gradually when a few "crystalline" bodies form within the plate, and these must be soon afterwards hollowed out and built upon. The same process takes place repeatedly against the sides of newly formed hexagons until the comb is large enough to suit the requirements of the bee; the sizes of the cells being partly influenced and regulated as above stated by the rapidity or otherwise of the process of cooling of the wax, and so

[1] A plate of wax formed by compression, and in which no hexagons had formed, was inserted in the hive—this the bees gnawed to pieces and (?) utilised elsewhere.

indirectly, as previously mentioned, by the thickness of the cooling mass. The size of the hexagons may be varied experimentally from those of nearly an inch across to others of microscopic dimensions.

At the time of writing this paper, we have not yet succeeded in casting a large sheet of wax containing groups or rows of hexagons so perfectly regular as those which are to be seen in a natural comb, or in a comb built upon the ordinary manufactured comb-foundation. We do not pretend, even after many experiments, to be able to cast a foundation of hexagons with the same comparative exactitude as those made by a bee. Although we have little doubt that we may soon be able to do so, we cannot expect, in a few limited experiments, to compete with the bee, whose seeming aptitude is probably the outcome of ages of natural selection and adaptation. Yet the bees still prefer to adopt our less regular groups or rows of hexagons as bases to work upon, rather than pull our wax plate to pieces, so as to recast the wax with greater regularity.

A further outcome of our discoveries is that paraffin wax and adulterated beeswax do not assume the same "crystalline" form as pure beeswax.

We have succeeded in producing a variety of characteristic forms of these "crystalline" bodies by the treatment of certain waxes with other fats, oils, or waxes. The analytical value of these experiments we may hope to prove to be very great, both directly and indirectly, and to open up an immense field of crystallography in its relation to oils, fats, and waxes.

It has also naturally occurred to our minds that the formation of certain intricate structures by other insects may be also more or less directly due to crystalline and pseudo-crystalline formations.

UCKFIELD, SUSSEX.

The Supposed Existing Ground-Sloth of Patagonia.

By A. Smith Woodward.

Much interest was aroused a year ago by Dr. Ameghino's announcement in *Natural Science* of the discovery of a piece of skin of a ground-sloth in Patagonia.[1] He supposed the specimen to belong to a small surviving representative of the gigantic extinct ground-sloths which were so abundant in the Pleistocene period in South America, and were known to have existed at least until the appearance of man in that country. Dr. Ameghino thought that this piece of skin might have belonged to a mysterious animal which had been described to him by the traveller Ramon Lista, so he named the new creature *Neomylodon listai*. With admirable conciseness he pointed out the main features of the skin—how it was completely covered with long dense hair, while being at the same time armoured by a close pavement of small nodules of bone embedded in the lower layer. He also quite correctly recognised that the bony armour was most closely paralleled by that dug up with the skeleton of the great extinct *Mylodon* in the Pampa formation in various parts of the Argentine Republic.

More precise details of this discovery were subsequently published by Dr. Moreno, Director of the La Plata Museum, and by Dr. Otto Nordenskjöld of Upsala; while a technical description of the skin itself was prepared by Dr. Einar Lönnberg and myself.[2] These additional communications showed that the specimen in question was dug up in the dust of the floor of a large cavern near Last Hope Inlet. They also seemed to prove that *Neomylodon listai* must have been at least as large as the well-known *Mylodon*—that is, not less in bulk than a rhinoceros. Notwithstanding the fresh aspect of the piece of skin, it thus appeared extremely improbable that the animal was still living, and had escaped the notice both of the natives and of explorers. Dr. Moreno, indeed, maintained that it was quite extinct, and dated back to a time when a former race of men, unknown even to the present Tehuelches, inhabited the southern extremity of the South American continent.

[1] F. Ameghino, "An Existing Ground-Sloth in Patagonia," *Natural Science*, vol. xiii. p. 324 (Nov. 1898).

[2] See *Natural Science*, vol. xiv. p. 265 (April 1899).

The Director of the La Plata Museum, with the characteristic energy which has established the fame of that great seat of learning, determined that no time must be lost in solving the problem of *Neomylodon*, so far as careful explorations could accomplish it. Dr. Rudolph Hauthal was accordingly deputed last April to undertake further diggings in the "Cueva Eberhardt," as the now celebrated cavern is named, and the results, just published, prove to be of the deepest interest.[1] These further discoveries include nearly all the important parts of the skeleton of the animal, evidently broken by man and clearly associated with relics of man himself.

It now appears that the remains of the so-called *Neomylodon* are not found at the exposed entrance of the cavern, which is of very large proportions (30 metres high), but occur only in an inner chamber which has every appearance of having been artificially constructed by cross-barriers. At a short distance from the entrance there is a rude wall of tumbled blocks extending the whole way across, except a narrow gangway left at one side. On passing through this the great chamber just mentioned is reached, and another wall-like barrier 50 metres further inwards extends completely across the cave from side to side, preventing any ingress except by scrambling. In the middle of the chamber there is an artificial mound. The floor proved to be covered with a layer of dust and stones, varying from 30 centimetres to a metre in thickness. In it at one spot were found numerous shells of mussels mingled with the broken bones of guanaco and deer—evidently the remains of the food of man. Beneath the surface layer near the inner barrier was discovered a great mass of excrement of a herbivorous animal, in some places more than a metre in depth. Most of the material was in the form of impalpable dust, which almost choked the workmen; but a few large lumps were in a good state of preservation, and rivalled the droppings of the elephant in size. Part of the heap showed clear indications of having been burned. Nearer the middle of the chamber was dug up a considerable accumulation of dry cut hay in a good state of preservation. In the lower layer—in the excrement, the hay, and the surrounding rubbish—were found numerous broken bones of the so-called *Neomylodon*, belonging to several individuals, both old and young, with another well-preserved piece of skin. There was also evidence of an extinct horse, and a large unknown carnivorous animal; while a human skeleton had previously (in 1895) been taken out of a niche in the wall of the chamber.

Summarising the results of his work, Dr. Hauthal specially emphasises the following facts:—

"1. That the deposit of excrement was confined to the space

[1] R. Hauthal, S. Roth, and R. Lehmann-Nitsche, "El Mamífero Misterioso de la Patagonia, 'Grypotherium domesticum,'" *Revista del Museo de La Plata*, vol. ix. p. 409, with five plates (Aug. 1899).

between the inner barrier and a mound—a space which could easily be shut off.

"2. That at the foot of the mound inside, but a little behind the excrement, there was found a considerable quantity of cut hay beneath the same layer of earth and stones which covered the excrement; while this hay could only have been placed in this situation by man.

"3. That the aspect of the layer of excrement indicates the existence of a stable, exactly as if it had been an old corral."

He thus concludes "that the men who lived there ages ago were accustomed to stable their domestic animals in this part of the cavern, reserving the rest for their own dwelling-place."

This extraordinary idea leads us to turn with expectant interest to the fragmentary remains of the so-called *Neomylodon;* for if the beast was a gigantic ground-sloth, it is inconceivable that so unwieldy a monster can have been of any use to man as a domestic animal or of any value to him except as food. The descriptions and figures published by Dr. Santiago Roth leave no doubt whatever that the quadruped in question was a gigantic ground-sloth; and the so-called *Neomylodon* is clearly proved to be identical with a *Mylodon*-like animal, already well known by the skull from the Pampa Formation of Argentina, described under the names of *Glossotherium* (Owen, 1840) and *Grypotherium* (Reinhardt, 1879). It is, in fact, a *Mylodon* with a very long head and laterally-placed nostrils. The species from Cueva Eberhardt is probably distinct from the *Glossotherium* (or *Grypotherium*) *darwini,* and will thus be known for the future as *Glossotherium listai.* After a ridiculous line of argument, which one would hardly expect to find in a scientific treatise, Dr. Roth proposes to change the specific name; but this point needs no discussion.

By the kindness of Dr. Moreno, the actual skull discovered by Dr. Hauthal and some pieces of the excrement were exhibited to the British Association at Dover; and the specimens will be further discussed at a forthcoming meeting of the Zoological Society of London. The animal must have been killed by man, for the cranium is battered on the top in three places. The blows themselves would probably merely stun the creature, for the air-chambers above the brain-case are too extensive to permit injury of the brain from above; but the men clearly had knives or sharp instruments of some kind, for there are distinct clean cuts on the remains. Pieces of periosteum, cartilage, ligaments and dried muscle still adhere to the bones. The specimens have a peculiar odour, and three of them exhibit no indications whatever of having been buried. Presumably these were dug out of the hay. They are, indeed, so fresh, that if the discoverers had reported that the animal had been killed shortly before the bones were packed up, the evidence of the specimens themselves would not have sufficed to contradict the story.

The excrement of the animal is of great interest, and was examined

by Mr. Spencer Moore in view of the British Association meeting. He reports that it "consists in large part apparently of grasses, as the haulms, leaf-sheaths, fragments of leaves, etc., of these plants are frequent in it. A spikelet, almost entire, of what seems to be a species of *Poa*, and the flowering glume of another grass, probably Avenaceous, have also been found. Besides these there is at least one dicotyledonous plant, almost certainly a herb, with a slender greatly sclerotised stem; though, as no attached leaves have so far been observed, its affinity is altogether doubtful." Mr. Moore also observes that there are numerous siliceous particles in the excrement, and several pieces of the underground parts of the plants, as if they had been pulled out of the ground. At the same time, he finds a few pieces which have been sharply cut in a way which the blunt teeth of *Glossotherium* (*Neomylodon*) could scarcely act. Since Owen's well-known and beautiful memoirs on *Megatherium* and *Mylodon*, it has always been supposed that the gigantic extinct ground-sloths fed on twigs and the leaves of trees. If his conclusions are well-founded, as seems almost beyond dispute, *Glossotherium* must either have been an exception to the rule owing to local circumstances, or it must have been doomed to an artificial mode of life by man who fed it. The authors of the memoir published by the La Plata Museum are all in favour of the latter view; and Dr. Lehmann-Nitsche even suggests that the famous cracked and repaired skull of *Mylodon* in the Royal College of Surgeons, immortalised by Owen, was not accidentally damaged by a falling tree, but bears the mark of an encounter with man in which the animal escaped. He mentions five similarly fractured skulls in the La Plata Museum.

Personally, we find it as difficult to believe that *Glossotherium* was a domesticated animal among the ancient Patagonians, as that it still lives in the wilds of the southern land where its remains are found. Dr. Hauthal's splendid discoveries only have the effect of making us eager for more. Mr. Graham Kerr's interesting speech at the British Association, expressing the opinion of one who has considerable experience of the South American Indian tribes, leaves little hope that huntsmen will ever find the beast. The Indians, in his opinion, are too keen field-naturalists to have escaped noticing the animal if it lives in their country. They know every track and trail. The impalpable character of the dust in the cave alone suggests intense dryness, and strongly confirms Dr. Moreno's idea that all the remains in Cueva Eberhardt are of great antiquity, notwithstanding their fresh aspect. More cave exploration in southern Patagonia is therefore urgently to be desired.

BRITISH MUSEUM
(Natural History Department),
LONDON, S.W.

FRESH FACTS.

A Strange Tail. Gustav Tornier. "Ein Eidechsenschwanz mit Saugscheibe," *Biol. Centralbl.* xix. 1899, pp. 549-552, 3 figs. The end of the tail of the lizard *Lygodactylus picturatus* is unique. It bears twenty attaching plaits in two rows, which form an effective sucker on the vacuum principle. The fingers and toes bear similar plaits, but each has only half as many plaits as the tail. The strange tail is an adaptation for clambering on the smooth surfaces of bananas and candelabra Euphorbias.

Fauna of Frog Spawn. Carl Thon. "Einige Beobachtungen über die Fauna, welche sich im Froschlaich aufhält," *Verh. Zool. Bot. Ges. Wien*, xlix. 1899, pp. 391-393. In ponds from two different localities in Bohemia, Thon found that the spawn of *Rana fusca* and *R. esculenta* had associated with it an almost identical set of small animals. A few days after hatching, small Dyticidae, *e.g.*, *Hydroporus*, made their appearance, but were not seen to injure the eggs; then water-mites, *e.g.*, *Eylais setosa;* then Entomostraca, *e.g.*, species of *Cyclops*, *Chydorus*, and *Cypris*, some of which helped to loosen the jelly. After hatching, many insect larvae appeared, *e.g.*, of *Cloëon dipterum*, *Ceratopogon*, *Chironomus*, *Perla*, *Limnophilus*, some of which devoured the young tadpoles greedily. Below the spawn lay *Asellus aquaticus* back downwards; nymphs of *Curvipes*, etc., were also abundant. Among the tadpoles, but hardly distinguishable because of their dark colour, were individuals of *Polycelis nigra*. After the empty spheres sank to the bottom, some encysted Vorticellids, many monads and diatoms, some statoblasts and ephippia were found amongst the jelly, but no infusorians or rotifers. Some of the associates loosen the jelly, others effect its further dissolution; others, again, make war with the tadpoles, but the protective value of the jelly is corroborated.

Branchial Respiration in Millipedes. M. Causard. "Sur la respiration branchiale chez les Diplopodes," *Comptes Rendus Acad. Sci. Paris*, cxxix. 1899, pp. 237-239. The observer found *Brachydesmus superus* in a brook under submerged stones, and was interested to notice that it evaginated two transparent ampullae from the rectum. He put *Polydesmus gallicus* in water, and observed the same phenomenon, and he succeeded again with a species of *Iulus*, so that the occurrence is probably not infrequent. The ampullae are formed from a protrusible rectal pouch, hitherto unobserved, and as they show tracheae and blood-currents, Causard does not hesitate to speak of a branchial respiration.

A Reducing Ferment in the Animal Organism. E. Abelous and E. Gérard. "Sur la présence, dans l'organisme animal, d' un ferment soluble réducteur. Pouvoir réducteur des extraits d'organes," *Comptes Rendus Acad. Sci. Paris*, cxxix. 1899, pp. 164-166. In extract of horse's kidney a soluble ferment was found which reduced potassium and ammonium nitrates, decolorised methylene blue, and seemed to form butyric aldehyde from butyric acid.

Breeding Habits of a Tree-Frog. J. S. Budgett. "Notes on the Batrachians of the Paraguayan Chaco, with observations upon their breeding habits and development, especially with regard to *Phyllomedusa hypochondrialis*, Cope; also a description of a new genus," *Quart. Journ. Micr. Sci.* xlii. 1899, pp. 305-333, 5 pls. The author observed a female of *Phyllomedusa hypochondrialis*, with a male upon her back, wandering about in search of a leaf whereon to lay her eggs. "At last the female, climbing up the stem of a plant

near the water's edge, reached out and caught hold of the tip of an overhanging leaf, and climbed into it. With their hind legs both male and female held the edges of the leaf, near the tip, together, while the female poured her eggs into the funnel, the male fertilising them as they passed. The jelly in which the eggs were laid was of sufficient firmness to hold the edges of the leaf together. Then moving up a little further more eggs were laid in the same manner, the edges of the leaf being sealed together by the hind legs, and so on up the leaf until it was full. As a rule two briar leaves were filled in this way, each containing about 100 eggs." Even more interesting, however, is the subsequent development.

HOW COPEPODS SWIM! E. W. MACBRIDE. "The movements of Copepoda," *Quart. Journ. Micr. Sci.* xlii. 1899, pp. 505-507. In the freshwater *Cyclops* the first antennae assist in the slow movements, and the belief is general that copepods propel themselves by their first pair of appendages. Prof. Macbride observed at Plymouth that the slow gliding movements of marine copepods are effected principally by the second antennae, the gnathites likewise assisting, notably the second maxillae. The quick movements, on the other hand, are effected entirely by the simultaneous action of the thoracic feet.

CLAMPS IN ANIMALS. OTTO THILO. "Sperrvorrichtungen im Tierreiche," *Biol. Centralbl.* xix. 1899, pp. 504-517, 13 figs. Dr. Thilo points out that one must serve some apprenticeship in engineering before one understands the animal body, and his ingenious essay bears this out. He leads us from the valves of the heart to the device which keeps the globe-fish's self-inflation from collapsing, but he is at his best in expounding clamps for rigid structures. From the clamp of the spine of *Monacanthus* (a fish from the Red Sea coral-reefs), we pass to more complex cases in *Triacanthus* and the stickleback, and the leverage-system which works the snake's fang is not forgotten. It is an essay for a dull afternoon, so ingenious is it; but it is with some misgivings that we are forced to conclude that in addition to mathematics and meteorology, statistics and spectroscopy, psychology and philosophy, and much more, the complete naturalist must also learn engineering.

VARIATIONS IN JELLYFISH. E. BALLOWITZ. "Ueber Hypomerie und Hypermerie bei *Aurelia aurita*, Lam.," *Arch. Entwickelungsmechanik*, viii. 1899, pp. 239-253, 1 pl. This common jellyfish seems to be an animal well deserving the attention of those who follow the modern statistical method of the study of variations. It is normally a tetra-partite creature, but sex-partite, pent-partite, and, more rarely, tri-partite forms may be found thrown up on the beach. Sometimes the variation is very consistent throughout; thus a tri-partite individual had a three-cornered mouth, three genital pockets, six marginal bodies, etc.; but, often, there is less uniformity and transitional forms occur. Some of the variations may be traceable to the Ephyra-stage, but most, according to Ballowitz, must have an earlier origin. Here is evidently a case for experiment to assist observation.

DIGESTION IN FISHES. EMILE YUNG. "Recherches sur la digestion des poissons (Histologie et physiologie de l'intestin"), *Arch. zool. expér.* vii. 1899, pp. 121-201, 1 pl. Prof. Yung has made many histological observations and physiological experiments in regard to digestion in fishes, and has removed some of the prevalent vagueness. The formation of pepsin seems rigidly confined to the stomach-sac and to a particular region of it.

THE PROBLEM OF EQUILIBRATION. TH. BEER. "Vergleichend-physiologische Studien zur Statocystenfunction. ii. Versuche an Crustaceen (*Penaeus membranaceus*)," *Pflüger's Arch. f. Physiol.* lxxiv. 1899, pp. 364-382. When the statocysts of *Penaeus* are extirpated, the animal can no longer keep its balance in swimming; it falls to one side or to the bottom.

SOME NEW BOOKS.

SCHARFF'S EUROPEAN FAUNA.

The History of the European Fauna. By R. F. SCHARFF. Contemporary Science Series, 1899. Pp. vii. + 364, Illustrated. London: Walter Scott, Ltd. Price 6s.

For many years Dr. Scharff, of the Dublin Museum, has been turning his attention to the important question of the origin and relations of the existing fauna of Europe. And the present volume, which includes the substance of a paper previously published, embodies the results of his investigations so far as they have been hitherto carried. Whatever may be the precise value of such results and conclusions, it may be unhesitatingly conceded that it is a great convenience to workers to have them in the form in which they are now presented. One great and praiseworthy characteristic of Dr. Scharff's work is to be found in the thorough manner in which he has looked up and quoted previous observers on the subject; and, if for no other reason, the little volume before us will always have a very considerable value on account of the views and opinions of a host of specialists which are brought together and contrasted and correlated. Moreover, the author has drawn his conclusions from almost all groups of animals, although admitting that the evidence derived from certain of these groups is entitled to much more weight than that afforded by others. In regard, then, to the perseverence and energy which he has brought to bear on a very difficult task, Dr. Scharff is clearly entitled to our best congratulations.

But whether he has succeeded in establishing the views he holds in such a manner as will lead to their general acceptance, is quite another matter.

As the author correctly points out, the fauna of Europe, as a whole, is a complex, including a mingling of essentially Arctic types with those of a Lusitanian or Mediterranean origin, as well as those characteristics of the heart of the area itself. Moreover, Dr. Scharff likewise accepts the view that a Siberian, or north-east Asiatic, element has been introduced into the fauna. With all these we are prepared to agree; but we venture to think that the author is much too fond of drawing wide-reaching conclusions from a very small amount of fact. Especially is this the case with regard to the "migrations" of which he is so constantly speaking. As an instance of what we mean, we may refer to the common hare and the wild boar, both of which are regarded as "Oriental immigrants" into Europe. Now, without venturing to deny that the author may be right in this contention, we do not hesitate to say that he has not adduced any evidence which is entitled to a moment's consideration in favour of such a view.

But in other instances it is not want of evidence that we have to deplore, but an actual misapprehension of the facts. The most glaring case of this is afforded by the inductions drawn from the reindeer of Europe. Here it is stated that two types of reindeer occur fossil in Europe, one of which, together

with the existing Scandinavian animal, is regarded as practically identical with the barren-ground reindeer of Arctic America, while the other is considered inseparable from the woodland reindeer of North America. The former of these, it is said, is found only in the extreme west of Europe, while the latter occurs in Central and Eastern Europe and Asia. And on this evidence it is argued that the barren-ground reindeer entered Europe by a land connection *viâ* Greenland and Iceland; while the woodland form made its way *viâ* Bering Strait.

At the conclusion of a very long argument he notices (p. 157) that a recent writer has denied the identity of the Scandinavian and the barren-ground reindeer, and then he proceeds to remark that "the whole subject is by no means as well known as could be wished, and a very careful comparative study of recent and fossil remains of the reindeer from various parts of the Old and New World, is much needed to put our views on a firmer basis."

This paragraph, coming after the conclusions definitely drawn as to the Greenland and Bering Sea routes, is equivalent to saying that so long as Dr. Scharff's views of the relations of the Old and New World reindeer are followed, everything is settled, but if anyone else ventures to take a different view, then the whole matter requires investigation (with the object, we presume, of re-establishing the Scharffian interpretation).

As a matter of fact, the Scandinavian reindeer, as all American naturalists are agreed, is a perfectly distinct animal from the barren-ground form; the only difference of opinion being as to whether they should be regarded as species or races. If Dr. Scharff is right in considering that there were two types of reindeer in Europe, their distribution may be perfectly well explained by assuming that the western or Scandinavian form wandered from Scandinavia by a land connection between that country and Scotland, and so on to Ireland, at a time when England was detached from Scotland and joined to the Continent. On the other hand, the second form might have spread over the whole of central and eastern Europe, and thus through Asia to America. There are no grounds, however, for deciding whether the Old or the New World is the original home of reindeer.

The author further assumes that the Irish stoat accompanied the so-called barren-ground reindeer into Europe by the Greenland route; while the English stoat arrived from Asia. The former can, however, scarcely be regarded as anything more than a race of the common stoat which has been isolated for a longer period than has its English representative. Consequently, although, as indicated by the plant evidence, there may have been means of communication at an earlier date, we fail to see any evidence for a land connection between North America and Europe by way of Greenland at the time when reindeer flourished in our own country,—that is to say, during, or just previous to the human period. Without any intention of rudeness, we may indeed suggest that writers should use common sense in matters of this sort; for the conclusions referred to are, in our opinion, sadly wanting in that very useful commodity.

Many other cases might be criticised, but the above is sufficient to show that all the author's conclusions are not to be taken as gospel.

In reading the book we have been much irritated by the author's fondness for repetition. For instance, Dr. Bonney is quoted no less than three times in support of the view that the boulder-clay may be a marine deposit; on pages 83 and 229 the very same passage is quoted at length twice over, while on page 180 it is paraphrased. As another example, we are thrice told (pp. 79, 185, 239) that Arctic and Alpine plants have to be protected in winter on the lowlands of Britain and the Continent. Moreover, in several places, there is, in our judgment, a want of clearness of expression in more than one passage. And there are not wanting instances of carelessness, as for instance, *barbarus* in lieu of *barbatus* on page 46. Then, again, we have always been under the impression that the genus *Agama* is the type of a family, and that it has no claim to

be regarded as a member of the Iguanidae (p. 193). Neither are we aware what animal is meant by the "Siberian Red Deer" (p. 249); but then (p. 248) the author does not appear to be aware of the essential distinction between a Red Deer and a Wapiti!

Should a second edition of what is in many respects a very interesting work be called for, we venture to hope that the author will modify some of his conclusions in regard to migration and former land connections, which appear to us to set probability at defiance.

AGRICULTURAL PROGRESS IN AMERICA

Year-Book of the United States Department of Agriculture, 1898. 8vo, pp. 768. Washington: Government Printing Office, 1899.

"The American Agricultural Year-Book" for the past year fully maintains the high reputation which the Department has justly earned by previous volumes of this publication. It is divided into three parts—(1) The Report of the Secretary of Agriculture to the President; (2) Miscellaneous Papers by chiefs of bureaus, divisions, and officers of the Department, or their assistants; and (3) An Appendix consisting of a summary of useful information. Five hundred thousand copies are annually printed and distributed, and so great is the demand that the Secretary recommends the increase of the current year's issue by 20,000 copies. Secretary James Wilson, or, as he would be designated in this country, Minister for Agriculture, is a native of Ayrshire, and springs from the same stock as the late Dr. M'Cosh of Princeton University. He left Scotland at the age of sixteen, and has, through his sterling worth and devotion to the best interests of agriculture, raised himself to the high position which he fills with much credit alike to himself and to the State. The Department is divided into over twenty distinct sections, each being worked by a staff of well-trained specialists. The Secretary's report refers to the leading results of the year's investigations, but we can mention only a few of the more important of these. We are told that the Department is searching the world for seeds and plants to diversify the crops of the country, and to add new varieties to meet sectional requirements. Four scientific explorers are abroad getting seeds and plants from Russia, around the Mediterranean, China, and South America. Of grasses, no less than 500 varieties are grown for educational purposes in the gardens of the Department. The Bureau of Animal Industry has discovered a substance which by means of one dipping will destroy all ticks infesting an animal, so that at last a remedy has been found to prevent the spread of Texas fever among cattle. Inoculation with antitoxin serum for the prevention of hog cholera has for two successive years saved 80 per cent of the animals treated, while as many as 80 per cent of the check herds not treated died. Important additions have been made to the Department library, which now contains nearly 65,000 volumes, and forms one of the largest collections of books on agricultural topics in the world. "Nature-teaching" in the common schools is receiving the special attention of the Department, as well as the great prerequisite, the education of the teacher. This is the natural development following the experience of what it is possible to do in agricultural colleges to meet the requirements of the country. In this connection America is immeasurably ahead of this country, where educational authorities have practically discarded the country schoolmaster as a teacher of agriculture, and are wastefully spending public money in duplicating agricultural colleges which are already far in excess of the requirements of the country, and are in the aggregate more than half empty.

The Weather Bureau is a most important and well-equipped section of the Department. So numerous are the Observation stations in all directions that forecasts not only of wind and rain, but of freezing weather, are made with such

accuracy and expedition that farmers are supplied with warnings which enable them to take precautions which result in the prevention of much injury to their field crops and fruits. In the Division of Soils progress has been made with the electric method of moisture determination. "The work includes the record of evaporation to which the plant is subjected, the water supply maintained by the soil for supplying the loss due to this evaporation, and the intensity of the actinic and heat radiations which influence the physiological activities of the plant." The electrical method of salt determination in soils has proved of special value in areas which have been over-irrigated. The year's expenditure of the Agricultural Department amounted to the enormous total of over £480,000 sterling, and about one-fourth of this sum was spent upon the printing and circulation of agricultural literature. So great is the desire for information through this source that the supply is not equal to the demand.

Among the thirty-six special articles which are comprised in Part II. of this bulky volume, may be mentioned the following, which have more or less direct interest to readers in this country:—Some Types of American Agricultural Colleges, The Danger of introducing Noxious Animals and Birds, The Preparation and Use of Tuberculin, Pruning of Trees and other Plants, Utilising Surplus Fruit, Construction of good Country Roads, Grass Seed and its Impurities, and Notes on some English Farms and Farming. The book is beautifully illustrated with 42 full-page plates, and 136 figures in the letterpress.

R. WALLACE.

INHIBITED.

On Inhibition. By B. B. BREESE. *Psychological-Review*, iii., 1899: Monograph Supplement, No. 41, pp. 65.

The author gives a long account of a very elaborate series of experiments he has lately made to determine what conditions, both subjective and objective, affect binocular rivalry. He first gives an account of the views held in regard to inhibition by many psychologists, from Spinoza to Ladd. He concludes that these may be classified into five conceptions, the first four entirely psychical, and the fifth psychophysical.

"Almost universally," he says, "the instances of inhibition cited by the foregoing psychologists involve definite bodily activities, either within the field of sense perception or bodily movements. These instances fall under the following classes:—

1. Inhibition of one sensation by another: A faint sound is inhibited by a loud sound; a slight pain by a greater pain.
2. Inhibition of bodily movements by sensation: A sudden sight or sound may inhibit movements of walking, breathing or the action of the heart. Pain may inhibit the movements which cause it.
3. Motor activity may inhibit mental states: Activity in battle may inhibit fear. Motor activity inhibits the feelings of embarrassment. If, when trying to remember a name, some other name very similar is pronounced the first name is inhibited.
4. Emotions may inhibit bodily functions: Shame inhibits the action of the vasomoter muscles. Great dread inhibits the flow of saliva. Great grief inhibits the flow of the blood to the brain.
5. Will may inhibit the voluntary and half-voluntary movements of the body, and, to a certain extent, the involuntary muscles. Some people are able to decrease the activity of the heart at will.

Experimentally he has investigated two phases of inhibition within this field:—

(1) Inhibition of one sensation by another, and
(2) Inhibition of mental states through suppression of their motor elements."

He then fully describes his experiments, and thus summarises the results:—

"The length of time which the fields normally remain in consciousness was increased by direct will power. Efforts to decrease the number of changes of the fields in a given time were unsuccessful. With the so-called pure will efforts there were in every case accompanying eye movements. Elimination of the eye movements decreased the ability to hold either of the fields. The introduction of conscious eye movements was accompanied by a lengthening of the time of the field whose lines served as the guide for the movement. Counting the lines upon either field increased the length of time that field remained in consciousness. Figures which induced the greatest eye movement remained longest in consciousness. The lines of a moving field remained in consciousness nearly all the time, but did not inhibit the normal rivalry of the two fields. Contraction of the right side or of the left side of the body had the same effect upon the rivalry, viz., increased the time which the field before the right eye was seen. Coloured borders did not affect the rivalry. Of two fields of different sizes, the smaller remained longer in consciousness. Under different conditions adjacent parts of the retinae showed different rates of rivalry at the same time. Increase in the intensity of the light stimulus caused an increase in the rate of the changes, while the ratio of the phases of the rivalry was normal and constant. Of two unequally lighted fields, the lighter remained longer in consciousness. After-images showed the same phenomenon of rivalry; but the changes occurred at a slower rate than in the case of direct stimulation. When both fields were of the same colour the rivalry of the two sets of lines was not affected. Different stimuli falling upon the same area of the retina of one eye produced the phenomenon of rivalry.

He then treats of the "inhibition of motor reactions" and concludes by an endeavour to apply his results to education. He advocates strongly motor training. His most pertinent criticism of our prevalent methods of school education is the following:—"We imprison the child for hours each day in his seat; meantime we try to teach him to think without giving him a chance to react."

"From the point of view to which this work leads, the value of manual training for the development of the mind—*i.e.*, as a culture study—finds its basis in the very nature of consciousness. Here we find an explanation of the fact that the boy who gains the ability to perform bodily adjustments in a decided, accurate and rapid manner is better able to think accurately and clearly, and why a hesitating and inaffective bodily reaction is the accompaniment of a weakened or confused state of mind." T. S. CLOUSTON.

A LOYAL DARWINIAN.

Darwinism and Lamarckism, Old and New. Four Lectures. By FREDERICK WOLLASTON HUTTON, F.R.S., etc. 8vo, pp. x. + 169. London: Duckworth & Co., 1899. Price 3s. 6d. net.

Captain Hutton's "excuse for adding to the already voluminous literature on Darwinism is that the subject is always advancing, and that the interest attached to it is not confined to naturalists, but enters into everyday life. It is, indeed, intimately connected with our systems of theology, for it forms one of the foundations—perhaps the corner stone—of Natural Religion. It is therefore important that a knowledge of the theory should be widely spread; and any attempt to convey that knowledge in simple language can hardly fail to do good, provided it be sufficiently clear to be understood at the first reading, and sufficiently short to discourage skipping."

But a new contribution to a subject so much over-written as this may perhaps be expected to justify itself by some particular quality, such as novelty of treatment, freshness of ideas, precision of statement, or up-to-dateness; but

we do not find this little book remarkable in any of these respects. It seems to us interesting rather as a clear exposition of the conclusions of one who began to write upon Darwinism in 1861, who has carefully examined many phases of evolutionary opinion, who remains after all a loyal Darwinian.

As one would expect from the author's varied contributions to natural history the book is saved by many concrete illustrations from seeming a merely logical discussion, and the exposition is on the whole delightfully clear, though it seems sanguine to hope that it will be altogether understood at the first reading. It requires some careful leading up before the reader can face with safety such a sentence as—"These indefinite variations may become definite through repetition; and are controlled in their development by the principle of selection, sometimes aided by use-inheritance."

As an old experienced hand, Captain Hutton is very careful in his use of terms, but occasionally his usage seems open to question. He speaks, for instance, of "the theory of development" contained in the "Origin of Species," but this phrase is more appropriately kept for the attempts to understand ontogeny. Similarly, when he says that "selection has no power if the individuals are not competing," he is either guilty of gross exaggeration or of an unjustifiable use of the word "compete," which seems almost irrelevant in those cases where the struggle is between the living creature and the inanimate environment. It seems to us also regrettable that the author does not take advantage of the distinction between modifications and variations which has been clearly defined and widely accepted, and saves a lot of time.

As to up-to-dateness, the book shows much of this quality, and yet not quite enough, for it is regrettable that suggestions like those in Weismann's "Germinal Selection," or in the so-called "Organic Selection Theory," should have been passed over in silence.

The first lecture on the scope and limitations of Darwinism is a fine illustration of successful exposition, to which personal reminiscences add interest. How many pages might have been saved—might still be saved—for more profitable use if critics would study Darwin's works as the author has done, or would even carefully acquaint themselves with a summary like this lecture. We need only recall Darwin's sentence—"Natural selection has no relation whatever to the primary cause of any modification of structure"—as a good instance of one of those so often forgotten.

The essence of the new Darwinism, according to the author, is found in the theory of isolation, which furnishes some sort of interpretation of the persistence of useless characters and incipient useful characters, and of the origin of divergence. A further difficulty—the existence of mutual sterility between different species—remains; but the author gets rid of it by saying:—"It has been shown to be outside Darwinism altogether; which is a theory of the preservation and development of variations, and not of their origin." As an example of the style, we may cite from this lecture the following passage:—"We may liken the progress of organic evolution to the march of an army, which is continually throwing off numerous scouting parties, who penetrate into every nook and cranny, and leave nothing unexplored. The few that find roads, lead off part of the army after them; while the majority, who fail to do so, perish on their tracks, and are heard of no more. Natural selection preserves and intensifies adaptations, or utilitarian characters only; isolation preserves both utilitarian and non-utilitarian characters. Progress is due to the former, variety to the latter." Thus the new Darwinism lifts us "out of the deadly region of utilitarianism into an altogether higher and purer air." Indeed, the air is so high and pure that we find it unsuitable for everyday respiration, for the author leads us to "the conclusion that all these so-called useless structures, all that give us beauty and variety, have been specially designed for man's education."

A condensed statement of the author's views would read somewhat as

follows:—He is willing to admit some use-inheritance or kinetogenesis, *e.g.* to explain the eye in flat-fishes and the tendrils of *Ampelopsis;* as panmixia cannot cause degeneracy and the principle of compensation of growth is an unproved hypothesis of a very doubtful character, disuse-inheritance seems to him necessary to explain many vestigial organs; environmental influence or physiogenesis is a true cause of variation, but these variations are not transmitted to other generations unless the same variation has been impressed over and over again on many successive generations; the most reasonable hypothesis appears to be that the physico-chemical forces affect, in time, the germ-cells; and that the changes thus produced become congenital variations, capable of being transmitted to future generations, and forming the material on which the various forms of selection and isolation may work.

We must not lay down this interesting book without noticing one of its most remarkable features, namely, the expression of the author's conviction that the outcome of the theory of evolution will be uniformity of religious belief.

J. A. T.

THE SCIENTIFIC SPIRIT.

Studien und Skizzen aus Naturwissenschaft und Philosophie. I. Ueber wissenschaftliches Denken und über populäre Wissenschaft. By Dr. AD. WAGNER. 8vo, pp. 79. Berlin: Gebrüder Borntraeger, 1899. Price 1 mark, 20 pfg.

This is the first of a series of booklets intended to introduce the reader to the problems of science and philosophy, not by didatic discourse or condensed summary, but by a more humane, indeed almost conversational, method. As an expert might tell us the meaning of the differential calculus in much less than half an hour, or of the theory of organic selection in five minutes, so will the author of these "Studien und Skizzen" instruct us concerning evolution and development, the freedom of the will and egoism, instinct and morals in a series of dainty little books which can be carried in the breast-pocket. It is a most laudable intention, and the prospect held out to us becomes the more enticing when we are told that the reader will be brought into touch with thought rather than with knowledge—in short with the scientific spirit rather than with the body of science.

The present volume deals with scientific thought—"wissenschaftliches Denken"—its aims and methods. It is easy to say—"the advancement of knowledge and the search after truth," but the conception of knowledge and truth seem to be as plastic as soft wax. "Tausend Gelehrte—tausend Ansichten." So much so that the public has become more or less consciously sceptical and shy of philosophy ("philosophiescheu"), and has fallen back into an intellectual slough which is called matter-of-factness. And even among the initiated the spectacle is seen of Philosophy receiving a pitiable alms at the door of the scientific mansion.

As a relief from this sluggish scepticism on the one hand and arrogant superficiality on the other, Dr. Wagner suggests that every man may be his own thinker. "Nur was selbst durchdacht ist, hat geistigen Wert . . . Immer und ewig ist die Parole: Selbst denken." This being granted, we are led by the author's lively conversation step by step to the conclusion—for which no novelty is claimed—that an unphilosophical science is a contradiction in terms, that there can be no wissenschaftliches Denken without a criticism of categories.

X.

AFRICAN FLORA.

Catalogue of the African Plants collected by Dr. Welwitsch. Vol. II. Part I. Monocotyledons and Gymnosperms. By A. B. RENDLE, M.A., D.Sc. 8vo, pp. 260. Printed by order of the Trustees of the British Museum. London, 1899.

The issue of this, the fourth, part of the Catalogue of Dr. Welwitsch's African plants within three years after the appearance of Part I., augurs well for the completion of the work in the near future. There is wanting to complete the account of the seed-plants only a few families of gamopetalous and the apetalous families of dicotyledons. This will presumably form a fourth and last part of vol. i. The work when finished will be a valuable contribution to our knowledge of the tropical African flora. No collector, however assiduous, collects everything, but examination of this and previously issued parts will show that Dr. Welwitsch obtained, during his eight years' stay in the country, not only a large number of species, but in most cases a good series of specimens illustrating geographical distribution of individual species. The account of his collections is therefore practically a Flora of that portion of West Tropical Africa which lies south of the equator. The district comprises Angola proper and the more southerly provinces of Huilla and Mossamedes, and the richness of the flora is evident from an analysis of the monocotyledons. All the African orders, comprising twenty-seven out of a total of thirty-four, are represented, and these include no less than 209 genera with 800 species. The most important are the orchids, with 18 genera and 76 species; Liliaceae, with 23 genera and 92 species; Cyperaceae, with 17 genera and 166 species; and grasses, with 75 genera and 268 species. Scitamineae, Amaryllideae, and Aroideae are also well represented. In striking contrast is the paucity of Gymnosperms. There are no Cycads and no Conifers, while the third order Gnetaceae is represented by a single endemic species of *Gnetum*, and that strangest of all seed-plants, the discovery of which we owe to Dr. Welwitsch, and which has hitherto been generally known as *Welwitschia mirabilis*. Unfortunately the rules of nomenclature will not allow this name to stand. It was proposed by Sir Joseph Hooker in honour of the discoverer in 1862, but exactly a year before a short notice had been published by Welwitsch himself, in which he suggested the name *Tumboa*, from the native name of the plant. So *Tumboa* it must be.

By the way, and the remark applies to the other parts which have appeared, we note with some regret the absence of plates. In the present part no less than 113 new species are described, and however full a description may be, there can be no two opinions as to the additional value of such plates as we are accustomed to associate with British Museum catalogues. A general account of the flora of the district in question would also form a useful appendix.

MODERN CHEMISTRY.

Grundriss der Allgemeinen Chemie. By W. OSTWALD. Third Edition. Pp. xvi. + 549, 57 figs. Leipzig: Engelmann, 1899. Price 16 marks, bound 17·20 marks.

This book, in its earlier editions, is well known, more particularly to the younger generation of students of chemistry. The first edition appeared in 1889, but in the ten years that have passed between that date and the appearance of this third edition, much new work has been done in the department of physical chemistry, or general chemistry as our author calls it. It is not the chemist alone who is indebted to Professor Ostwald for constituting himself the chief exponent of the newer views and their numerous applications, as he has

done in the present work and his other publications. New light is thrown by these views upon the operations of analytical, of organic, of technical, and in fact of all branches of chemistry; but the physicist and the physiologist will also find many obscure places rendered clearer when they become familiar with chemistry in its more recent physical development.

While the *Grundriss* is not a beginner's book, it is, relatively speaking, an elementary work, and it will serve to prepare the reader for the study of the same author's *Lehrbuch*, in which the subject is much more fully elaborated. In the present edition the book has been virtually re-written and is in many respects improved. Its appearance will be warmly welcomed by all who desire to see, and to assist in, the spread of the new chemical theories; and we are glad to think that the number of these persons is now rapidly increasing.

L. D.

GRADUS AD SCIENTIAM.

Progressive Lessons in Science. By A. Abbott, M.A., and Arthur Key, M.A. Pp. xi. + 320, with figures. London: Blackie and Son, Limited, 1899. Price 3s. 6d.

The first part of this book is an easy guide to a knowledge of the chemistry of air and water, and of such other portions of elementary chemistry as are considered requisite for an intelligent study of the second part. It is illustrated by means of simple experiments which, while not presenting any specially novel features, are, on the whole, well chosen; although they do not, in all cases, carry conviction regarding the conclusions intended to be drawn from them. The chapter on acids, bases, and salts can scarcely be regarded as satisfactory. The second part deals with the recognition, by chemical means, of the elements concerned in the building up of animal and plant tissues and with tracing these elements, generally, from the animal to the plant and from the plant to the soil. It may well be doubted whether this part does not demand too special a knowledge of certain very limited facts and methods of analytical chemistry to be of great use to pupils from a broad educational standpoint. The get-up of the book is good, and very few misprints have been met with. L. D.

VEGETARIANISM.

The Logic of Vegetarianism: Essays and Dialogues. By Henry S. Salt. 8vo, pp. 119. London: The Ideal Publishing Union, Limited, 1899. Price 1s.

In justification of the form of these essays, the reader has to bear steadily in mind that they were in the first instance published in *The Vegetarian*, and thus addressed to those already in sympathy with the writer's convictions. It would otherwise have been a serious tactical error to have personified his dialectic opponents under the titles he has selected. "Verbalist" and "Superior Person" may describe accurately enough one's idea of the mental condition of his adversaries, but they are not initiatory compliments such as smooth the course of an argument, and even "Patriot," when spoken with particular emphasis, may convey an irritating insult and cause much unhallowed rancour. What is perhaps more unfortunate from the critic's standpoint is that the mere use of these terms is in itself an argument which embodies a material fallacy described in text-books of logic under the heading of *petitio principii*. If, however, we pass these matters with a smile, much of the author's argument, especially on the ethical importance of food reform, will be found worthy of more than a passing thought. The weakness of the logical position of vegetarianism is, as Mr. Salt is fully aware, that its argument has to convince not reason but habit. B.

VARIATIONS IN BUTTERFLIES.

Ueber einige Aberrationen von Papilio machaon. By Prof. J. W. SPENGEL. 48 pp. 3 pls. Jena: G. Fischer, 1899. Price 2 m. 50 pf.

Dr. Spengel's valuable paper on varieties of the common European "Swallowtail" Butterfly, which appeared in the *Zoologische Jahrbücher*, will be welcomed by entomologists in this separate form. After a careful description of the wing-markings and their position with regard to the nervures in typical examples of *P. machaon*, the author proceeds to an account of the various named aberrations which have been met with, his remarks being illustrated with excellent coloured figures. Specially noteworthy are the forms *evittata*, in which the black and blue sub-marginal bands are wanting; *nigrofasciata*, a melanistic form in which the red eye-spot of the hind wing tends to disappear; and *nigra*, in which all the wing-surfaces are suffused with black. Evidence is brought forward to show that the production of the melanic varieties does not depend necessarily on low temperature. The very remarkable form, *elunata*, is a monstrosity in which the wing-nervures are most imperfectly developed, they almost vanish towards the hind margin of the wing, and the sub-marginal dark band shows accordingly no segmentation. Dr. Spengel has materially advanced our knowledge of a fascinating subject.

G. H. C.

THE AFFINITIES OF THE TERMITES.

We have received the second and third parts of Mr. W. W. Froggatt's monograph of the Australian Termitidae (*Proc. Linn. Soc. N.S. W.*, 1896, 1897), comprising the general classification of the family and a detailed description of the known Australian species. In his discussion of the relationship of the Termites to other insects, Mr. Froggatt leans to the view that they have closer affinities to earwigs and cockroaches than to any other group, and that they should therefore be included among the Orthoptera rather than among the "Pseudo-neuroptera."

AUSTRALIAN ECONOMIC ENTOMOLOGY.

Mr. Froggatt is also devoting attention to injurious insects in New South Wales. A paper by him on "Gall-producing Insects," with special reference to Coccids, is published in the *Agricultural Gazette, N.S. W.*, 1898, while in conjunction with Messrs. Allen, Blunno, and Guthrie, he has issued an excellent illustrated pamphlet on "Insect and Fungus Diseases of Fruit-trees." The various pests are grouped according to the trees which they injure. Each species is clearly figured, and the best means for clearing the orchards is plainly described.

DIARY OF TWO ORNITHOLOGISTS.

Bird Life in an Arctic Spring. The Diaries of Dan Meinertzaghen and R. P. Hornby. Crown 8vo, pp. 150. London: R. H. Porter, 1899.

This dainty little volume has been published as a memorial of Dan Meinertzhagen, who recently succumbed to a brief illness at the early age of twenty-three. He was always devoted to birds, and had made a special study of the Raptores, upon which he hoped to complete a Monograph. But the material which has found its way into print is a literal transcript of a private journal kept during a visit paid to Finland in the summer of 1897, supplemented by the notes of the young sportsman who shared his hardships. The

diaries of the friends were written up as occasion permitted, often at the end of a long fatiguing day, and cannot be said to do more than sketch the bird life to be found in the forests of Northern Europe; but they are vivacious, and have the merit of severe accuracy. While many of the birds that inhabited the neighbourhood of Muonioniska proved to be species that can be studied in the British Islands, such as the Capercaillie, Osprey and Merlin, others were characteristic of the far north, such as the Lapp Owl, Pine Grosbeak and Siberian Jay. Dan Meinertzhagen was an accomplished draughtsman as well as a good naturalist, and he found time to make some capital sketches of birds that he encountered, *e.g.* that of the Hawk Owl which is reproduced at p. 74. Had his life been spared for a few years, he might well have ranked as one of the first zoological painters of the day. The twenty-seven plates bound up at the end of the volume show the pains which he had taken to master the technique of his art. Perhaps he excelled most in delineating the attitudes of birds of prey; but he was also adept in preparing drawings of anatomical dissections. The feeling of regret which all readers of "Bird Life in an Arctic Spring" will experience, after perusing the story of a life of brilliant promise suddenly cut short, is deepened by the knowledge of the amiable disposition of this ardent naturalist, who readily won the regard of all with whom he came into contact. The fresh and vivid impressions of Arctic bird life which his rough jottings convey may well inspire others to follow in the wake of his investigations. H. A. M.

RENAL SECRETION.

Les Fonctions Rénales. By Prof. FRENKEL of Toulouse. Pp. 84. [Scientia.] Paris: Georges Carré and C. Naud. 1899. Price 2 francs.

In this little book of eighty-four pages, Prof. Frenkel has given a very interesting account of the physiology and pathology of renal secretion. In the first chapter there is a short but well-written description of the structure of the kidney, and this is followed by one dealing with the composition of the urine, in which the biological properties of the latter are specially emphasised. As one would naturally expect, seeing that the work has been largely done by French scientists (Bouchard, Charrin), a much larger amount of space is devoted to the toxicity of the urine than is ordinarily met with even in far more ambitious text-books in other languages. Although many of the hypotheses, which the author formulates in regard to the properties of the urine, may be considered to have insufficient basis, all must admit that the author has stated his case clearly. The third chapter, on the physiology of renal secretion, goes over well-known ground, the theories of Ludwig and Bowman-Heidenhain being shortly referred to; but recent English work is not mentioned. The fourth chapter deals with a department with which the names of Brown-Séquard, Teissier, and the author are associated, viz. the nature of internal renal secretions. In this country and in Germany, much more attention has been paid to the secretions of the pancreas, thyroid and supra-renals, than to renal secretions. The last two chapters treat respectively of what the author terms, pathological physiology of the renal secretion and renal permeability and insufficiency. The little book may be heartily recommended to all interested in this subject. T. H. MILROY.

The *American Naturalist* for September has the following articles:—"A Contribution to the Life-History of *Autodax lugubris* Hallow, a Californian Salamander," by W. E. Ritter and Love Miller; "The Worcester Natural History Society," by H. D. Braman; "Synopsis of North American Caridea," by J. S. Kingsley; "The Life Habits of *Polypterus*," by N. R. Harrington; and "Pads on the Palm and Sole of the Human Foetus," by R. H. Johnson.

The *Halifax Naturalist* for October has the following contents:—"Scraps of the Life-History of Insects," by Miss Theodora Smith; "The Life-History of the Autumn Crocus," by C. E. Moss; "Moorland Moths," by E. Halliday; "Haugh End," by J. Longbottom; "The Flora of Halifax," by W. B. Crump; Field work in winter; and Notes.

The *Naturalist* for October has papers on "Air Blasts below Ground," by H. Preston; on "Botanical Finds in Cumberland," by W. Hodgson; on "Nottinghamshire Diptera," by Rev. A. Thornley, and on the "Florula of Bare, West Lancaster," by F. Arnold Lees.

The Canadian Record of Science, after eight months' delay, brought out the first number of its eighth volume on 1st September. The publication committee of the Natural History Society of Montreal hopes in future to present the *Record* regularly each quarter. The number before us contains a paper by Professor E. W. M'Bride on "Zoological Problems for the Natural History Society of Montreal," much of which is applicable to other societies of the kind. The main contention is that, when once the local society has compiled complete lists of the local fauna and flora, the attention of the naturalists should be directed to the study of each species in relation to its environment. How far are the distinctive characters of a species concordant with its special habits? What prevents two species living side by side from intermingling? How far have the species of the systematists a physiological validity?

Other papers are a list of "The Gramineae, Cyperaceae and Juncaceae of Montreal Island," by Harold B. Cushing and Robert Campbell, and "Dimorphism and Polymorphism in Butterflies," by H. H. Lyman.

The study of small mammals has, as many other studies in zoology, arrived at a stage where the chief desideratum is enormous quantities of individuals for purposes of minute comparison. At the same time the study is so refined that the specimens, to be of service, must all be prepared in a similar manner. Those who are willing to help specialists by collecting for them will be glad to have instructions clearly and compactly placed before them; and this they can now find in a pamphlet entitled "Directions for Preparing Study Specimens of Small Mammals," issued by Gerrit S. Miller, Jun., as Part IV. of *Bulletin of the U. S. National Museum*, No. 39 (10 pp. Washington, 1899). Special hints for tropical climates are furnished by E. W. Nelson, the well-known collector.

Knowledge for October is a strong number,—Professor Arthur Thomson of Oxford discusses "Cranial form"; Sir Michael Foster's presidential address at Dover is expounded; H. F. Witherby continues his account of two months' natural history on the Guadalquiver; Mr. Stebbing continues his wonderful story of the Karkinokosm; Mr. W. S. Bruce, lately returned from a cruise with the Prince of Monaco, deals graphically with a haunt of his—the top of Ben Nevis; Mr. J. E. Gore still discourses with interest on some suspected variable stars, and Prof. Cole introduces the reader to the secret of the Great Earth-mill, and there is more besides.

The *Quarterly Review*, No. 380, published on the 18th October, has an illustrated article on "The Penycuik Experiments," which were discussed in our last volume.

The *Journal of School Geography* for September has the following articles: —"Equipment of a Meteorological Laboratory," by R. De C. Ward; the Earth's Interior," by J. A. Bownocker, "Niagara Falls, and the Commerce of the Great Lakes," by C. A. M'Murry, and "the Caroline Islands."

We have received a number of agricultural papers of interest, though dealing with matters somewhat beyond our scope. From the Department of Agriculture in the University of Aberdeen comes a report on an investigation with

regard to the value of tuberculin as a test of the presence of tuberculosis in cattle, by J. M'Lauchlan Young, F.R.C.V.S. and Dr. J. S. H. Walker. The numerous and clearly displayed statistics show that when used with care and under proper conditions tuberculin is a reliable diagnostic of tuberculosis in cattle, except (*a*) when the tubercular lesion is minute, or (*b*) when the disease has become generalised, especially in the case of aged and emaciated animals. Two other conclusions reached are that tuberculin (as has been previously pointed out) loses its virulence when kept for a time, and that tuberculous udders are more frequent than is generally believed to be the case.

From the Department of Agriculture of New Zealand comes a report on swine-fever by J. A. Gilruth, M.R.C.V.S., chief government veterinarian and bacteriologist, in which it is shown that pulmonary and pleural lesions may, and frequently do, occur along with, or independently of, the so-called bowel-lesions of swine-fever. It is doubtful if the hog-cholera and the swine plague of America are two distinct diseases as they are reported to be. It is possible that as the thoracic lesions of swine-fever seem to be the more frequent and more marked phenomena of the disease, this may be the key to the non-success of the stamping-out order in Britain, which only takes account of the gut-lesions, not to mention that the virulence of the disease seems to increase and diminish from unknown causes—an unfortunately necessary lame ending to the report.

The *Irish Naturalist* for October contains the following short papers:—"Some Animals from the Macgillicuddy's Reeks," by R. F. Scharff and G. H. Carpenter; "Migratory Butterflies in S. W. Cork," by J. J. Wolfe; "*Matricaria discoidea* in W. Ireland," by N. Colgan, with a note by C. Lloyd Praeger; "*Poa compressa* as an Irish Plant," by J. H. Davies; and Notes.

The *Scientific American* for Sept. 23 has an article on women in science, based upon a recent work by Rebière, in which the rôle of honour is traced from Hypatia onwards to Sofia Pereyaslawszewa, and indeed to our midst. The fact is that to recognise the sex-distinction in scientific work is now almost an impertinence.

In *Nature Notes* for October, besides the usual Selborniana characterised by sensible humanitarianism, there are "Observations on the Origin and Dispersal of Fruits and Seeds," articles on the regeneration of the New Forest, by a Selbornian, and on batrachians as pets by G. Renshaw, and other interesting matter.

The fourth number of *L'Anthropologie* for 1899 contains *inter alia* a re-discussion of polymasty and polythely in man by Dr. P. J. Stoyanov.

In *Science Gossip* for October there are, besides continued articles, various short papers:—"A Heronry in Asia Minor," by J. Bliss. "Irish Plant Names," by J. H. Barbour; "Radiography" (with figure of a rabbit's fore parts), by J. Quick; "Manganese in River Gravels," by M. A. C. Hinton; "The Birch and the Alder," by Dr. Keegan; and "Larvae of Caprella," by E. H. Robertson.

The *Scientific American* for September 9 republishes Mr. Lydekker's article on "A Contrast in Noses," for which they are indebted to *Knowledge.*

We have received from the University Corresponding College Press "The London University Guide for the year 1899-1900," which bears a protective resemblance to a University Calendar, and is full of valuable information for intending students.

Messrs. Clay, Cambridge University Press, announce the fourth part of Dr. Willey's "Zoological Results," Parts I. and II. of the second volume of "Fauna Hawaiiensis," and the second volume of Mr. Seward's "Fossil Plants."

OBITUARY.

GEORGE DOWKER.

BORN, APRIL 2, 1828; DIED, SEPTEMBER 22, 1899.

KENT has to deplore the death of one of her foremost geologists, botanists, and archaeologists. Mr. Dowker had only returned from the meeting of the British Association a few hours before his death, which occurred quite suddenly at his home in Ramsgate. Born at Stourmouth House, Stourmouth, he was educated at Sandwich Grammar School, and trained for agriculture at Hodsdon Agricultural College. He began farming his father's estate at the early age of 30, but science claimed too much of his time to allow of his success. As a botanist, Dowker was the authority on Kentish plants, many of the rarer species in the *Flora of Kent*, edited by Hanbury and Marshall, being associated with his name. As geologist, he was responsible for numerous papers, notably "On the Chalk of Thanet," and "On the Water Supply of East Kent." As a microscopist, he was acquainted with the pond life of his district, and at one time was president of the Margate Microscopical Club. As archaeologist, he contributed to *Archologia Cantiana* many valuable papers on Richborough Castle, The Reculvers, and Roman antiquities at Wingham, Preston, and other places, and he it was who described the Saxon Cemetery at Wickhambreaux.

Dowker's collection of chalk flints is now in the Maidstone Museum, but he leaves behind an excellent herbarium of wild plants. He was buried at Stourmouth, and Kent has lost a devoted and earnest student of a class only too rare in Thanet.

The following deaths have been recently announced:—GRANT ALLEN, *facile princeps* as an exponent of evolutionary natural history, on Oct. 25, in his 51st year; Prof. MAX BARTH, director of the agricultural experiment station in Rufach (Alsace) on August 28, in his 44th year; on October 6, at the age of 63, JOHN BRIDGMAN, entomologist and a vice-president of the Norfolk and Norwich Naturalists' Society—he had presented his collections to the Norwich Museum; SIGISMONDO BROGI, a well-known naturalist in Siena, on July 17, at the age of 48; Dr. KARL BERNHARD BRÜHL, formerly professor of zootomy in the University of Vienna, on August 14, in Graz, at the age of 79; J. B. CARNOY, professor of botany in the Catholic University of Louvain, editor of *La Cellule*, well known for his researches on cell-structure and on the phenomena of maturation and fertilisation, on September 8, during a holiday in Switzerland, 63 years of age; Chief-Justice C. P. DALY, at the age of 84, for many years president of the American Geographical Society, to which he rendered great services, also an enthusiastic botanist and one of the managers of the Botanical Garden of New York; Prof. THEODOR ELBERT, geologist in Berlin, at Gross-Lichterfelde, in his 42nd year; Prof. JOSEPH ERHARDT, formerly director of the Natural History Museum in the Castle at Koburg, in his 80th year; Dr. W. D. HARTMAN, conchyliologist, in West Chester, Pa., on August 16; at Geneva, HIPPOLYTE LUCAS, entomological assistant in the Paris Museum of Natural History; on September 29, Dr. C. RUSS, ornithologist, of Berlin; JULIUS SCHARLOCK, an enthusiastic florist, at Graudenz, on August 14, in his 90th year; CHRISTIAN SCHWEMMER, botanist in Nürnberg; Dr. FRIEDRICH THEILE, author of several publications on natural science, at Lockwitz, near Dresden, in his 85th year; GASTON TISSANDIER, founder and editor of the scientific weekly, *La Nature*, in Paris, on September 8, aged 56; Rev. WILLIAM FARREN WHITE, entomologist, on July 21, at Bournemouth, in his 66th year.

CORRESPONDENCE.

RAINFALL.

Dear Sir—Without being able to positively assert that the statement on p. 308 of *Natural Science* (October) that 351 inches of rain fall in N. England and Scotland, and that London has ten times the rainfall of Paris, is completely wrong, I believe it to be incorrect. At the Stye, near Seathwaite, Cumberland, the average is 177 inches ("Bartholomew's Physical Atlas," vol. iii. Meteorology, p. 20); at Ben Nevis 151 inches. In De Lapparent's *Leçons de Géographic Physique* on p. 65, map Repartition des Pluies en France, Paris occupies an area with 500 to 600 mm. rainfall = 20 to 24 inches, and in the atlas above mentioned (p. 22), Paris is said to have 20·7 inches of rainfall, that of London (p. 24), being 20 inches at Crossness, E.—Yours truly, Bernard Hobson.

Owens College, Manchester,
Oct. 10, 1899.

CAPE FISHERIES.

Dear Sir—Owing to absence from home my attention has only just been called to the letter by Dr. Gilchrist in your issue of September and to your editorial note below it.

I desire to say that I have not in any way either misunderstood Dr. Gilchrist or misinterpreted him, and must entirely dissociate myself from your note. I think that had the facts been placed fully before you the latter would not have been written.

Let us briefly recall the facts under discussion. In *Natural Science* for June (p. 431) I wrote:—"Dr. Gilchrist, the Government Marine Biologist, states in evidence that 'we know absolutely nothing about the spawn of the fish.' This statement seems to require some explanation, considering that the author of it has been over three years in Cape waters, and that an annual expenditure of 'between £3000 and £4000' has been placed at his disposal."

My justification for these remarks is to be found in the "Minutes of Evidence taken before the Select Committee on the Fishing Industry," contained in the Report under review.

Dr. Gilchrist in reply to Q. 658 by Mr. Maasdorp, after referring to the condition of affairs in British waters, says:—"The question here is very different. The evidence has shown that we know absolutely nothing about the spawn of the fish, or very little; we do not know whether it floats on the surface of the sea or whether it lies on the bottom. Some spawn has been seen, but it has not been identified to what fish it belongs" (p. 61).

The ordinary intellect would suppose that the meaning of those remarks is to the effect that Dr. Gilchrist agreed with "the evidence" and endorsed it. He cites the evidence himself and follows it up by remarks of his own agreeing

with it. All possible room for prevarication is removed by Dr. Gilchrist's answer to Q. 724. Here it is—

"724. Is anything definite really known about the spawn of our South African fish ?—Nothing. Several people have seen the spawn of some species of fish. It is said to discolour the sea for many miles" (p. 68).

In view of such evidence as this I fail to see the point of Dr. Gilchrist's letter, in which he implies that it was only the fishermen who stated that nothing was known about the spawn, and that he had facts up his sleeve bearing upon the question, or at least had not confessed his ignorance to the Commission.

When we recall to mind the conditions under which the spawning habits of our British fishes have been investigated, by the help of small sailing vessels or excursions on commercial trawlers, we feel quite justified in our remarks. The *Pieter Faure* appears to have been free to trawl whenever and wherever was most desirable, and we have only to conclude that for three breeding seasons she has caught thousands of fish which must have been in various stages of maturity, yet at the end of this time the scientific expert has to own that nothing definite is really known about the spawn of our South African fish. Doubtless there may be a good enough explanation forthcoming, but Dr. Gilchrist's letter does not shed any further light upon the matter.

We may take Dr. Gilchrist's word for it, in answer to the Chairman, that the *Pieter Faure* has not been used for "picnics and pleasure-trips," and can quite believe that the "people who came for picnics did not find it very agreeable" (Q. 680, p. 65), for the deck of a trawler is not an ideal place for such proceedings, but we feel that if more of the scientific results of the trawling had been produced on evidence there would have been no occasion for such a question.

The only other remark I made was that "the scientific voice seems to lack decisiveness." Here perhaps the term "accuracy" would have been preferable to "decisiveness," for a very few days' sojourn in any of our marine laboratories should have been sufficient to convince Dr. Gilchrist that it is not a "*theory* that the spawn of most fish" floats at the surface (Q. 725), but a *fact* capable of easy demonstration, and, secondly, that "the herring is" *not* "about the only fish known to spawn on the ground" (Q. 726).

From the above I trust it is clear that, although I may seem to have misunderstood Dr. Gilchrist, in this case things are not what they seem.—Yours, etc.,

THE REVIEWER.

Sept. 25, 1899.

CORRIGENDA.

Since the address affixed to the MS. of the "The Fauna of the Sound" (*Nat. Sci.* xv. pp. 263-273) escaped your notice, the proofs of that paper never reached either me or Dr. Lönnberg. The following corrections will bring the published pages into better agreement with the original MS. :—

P. 263, line 1, *for* nörande *read* rörande.
P. 263, line 2 from bottom, indenfor is one word.
P. 267, line 5 from bottom, *for* Shore-regions *read* Shore-region.
P. 269, 271, 272, *for* Bohustän *read* Bohuslän.
P. 266, in the italicised line, *for* Oscidians *read* Ascidians.

F. A. BATHER.

NEWS.

The following appointments have recently been made :—Dr. Ardaillon as professor of geography in the University of Lille ; Marshall A. Barber, as associate professor of cryptogamic botany in the University of Kansas ; Dr. G. A. Bates, as professor of histology in Tufts College Dental School ; R. K. Beattie, as instructor in botany in the Agricultural College at Pullman, Washington ; H. M. Benedict, as head of the biological department of the Nebraska State Normal School at Peru ; Dr. R. M. Buchanan, as bacteriologist to the City of Glasgow ; Judson F. Clark, as an assistant in botany in Cornell University ; Dr. E. D. Copeland, to be assistant professor of botany at the University of West Virginia ; Dr. Karl Josef Erich Correns, as titular professor of botany in the University of Tübingen ; Dr. Deichmüller, of the mineralogical and ethnological museum in Dresden, to the title of professor ; Dr. Julius Doeger as adjunct to the Austrian Geological Survey ; Dr. W. Figdor to be privat docent in botanical anatomy and physiology in the University of Vienna ; F. P. Gorham, to be assistant professor of biology at Brown University, U.S.A. ; H. Hasselbring, as an assistant in botany at Cornell University ; George J. Hastings, as an assistant in botany at Cornell University ; Dr. Max Hollrung, director of the Experiment Station for plant protection at Halle, to be titular professor ; Alfred Jentzsch, to be geologist at the Geological Landesanstalt in Berlin, in succession to the late Professor Th. Ebert ; Dr. J. B. Johnston, to be assistant professor of zoology at the University of West Virginia ; J. L. Kellogg, as assistant professor of biology at Williams College, Williamstown, Mass. ; Dr. F. D. Lambert, instructor in biology in Tufts College, U.S.A. ; Albert B. Lewis, assistant instructor in zoology in the University of Nebraska ; Miss Annie Lyons, as assistant in zoology at Smith College, U.S.A. ; Harold Lyon, assistant in botany in the University of Minnesota ; C. B. Morrey, to be assistant professor of anatomy and physiology at the Ohio State University ; Dr. Elisa Norsa, assistant in zoology in the University of Bologna ; Karl Reinhertz, as professor of geodesy in the Technical Institute in Hannover ; P. H. Rolfs, as professor of botany at Clemson College, and botanist to the Agricultural Experiment Station of South Carolina ; William Norman Sands, as director of the botanical station in Antigua ; J. L. Sheldon, instructor in biology in the Nebraska State Normal School ; Dr. Max Standfuss, as titular professor of zoology in the University of Zürich ; Dr. F. E. Suess, assistant on the Austrian Geological Survey ; Dr. F. Supino, to be assistant in the Zoological Institute of the University of Rome ; R. W. Tower, to be assistant professor of chemical physiology at Brown University ; Mr. W. H. Twelvetrees, as geologist to the Government of Tasmania ; F. E. Watson, graduate assistant in zoology in the University of Nebraska ; Professor W. M. Wheeler of Chicago, as professor of zoology in the University of Texas ; W. H. Wheeler, assistant in botany in the University of Minnesota ; Dr. A. Willey, as lecturer on biology at Guy's Hospital, London ; R. H. Wolcott, as adjunct professor of zoology in the University of Nebraska ; Ernst Anton Wülfing, as professor of geology and mineralogy at the Agricultural Institute in Hohenheim.

We learn from *Science* that Dr. R. Burckhardt, professor of palaeontology at Bâsle, and Dr. V. Uhlig, professor of geology in the German Technical Institute of Prag, have been elected members of the Academy of Sciences of Halle.

Professors D. J. Cunningham and W. C. M'Intosh have been appointed as scientific members of a commission to inquire into inland fisheries in Ireland.

Ernst Ebermayer resigns his professorship of forestry in the University of München.

W. von Ahles resigns his professorship of botany in the Technical Institute in Stuttgart.

A bacteriologist is wanted for the Glamorgan County Council and Cardiff Corporation, who shall also lecture on bacteriology in the University College, Cardiff. The salary is £300. Applications have to be sent before 6th November to Mr. W. E. R. Allen, County Offices, Cardiff.

During October the Swiney Lectures on Geology in connection with the British Museum (Nat. Hist.) were delivered by Dr. R. H. Traquair, who chose for his subject the "Pleistocene Mammalia." Since the Natural History Museum is still without a lecture-theatre, the course was given at the Museum of Practical Geology. After next year, when Dr. Traquair's appointment terminates, the post will be open to any doctor of medicine or science of the University of Edinburgh.

A curious thing about this lecturing at Jermyn Street is that the audience is far smaller than it used to be at South Kensington. However convenient Jermyn Street may be for the agriculturist in search of water, or the mining speculator who wants an analysis of a new sample of ore, it is, in the opinion of the Swiney lecturer, more remote from the ordinary student of natural science than is South Kensington. This tells against those who wish to keep all the Survey collections in their present confined quarters.

A circular from an influential committee formed at the Dover meeting of the British Association is headed with the words: "It is at least probable that the closing year of the nineteenth century, in which science has played so great a part, may, at Paris, during the great World's Fair—which every friend, not of science only, but of humanity, trusts may not be put aside or even injured through any untoward event, and which promises to be an occasion not of pleasurable sight-seeing only, but also, by its International Congresses, of international communing in the search for truth—witness the first select Witenagemote of the Science of the world."

It proceeds to say that, "Following upon the hopes and counsels of Sir Michael Foster's Presidential Address and upon the reunions of the British and French Associations, it is felt that the time is now ripe for some more permanent organisation which should maintain, develop, and utilise the good relations thus so fully initiated. It is therefore proposed to form a General and Advisory Committee consisting of members of the British Association, the Association Française, and of other representatives of Pure and Applied Science, Education, Art, etc., with the object of promoting arrangements for an International Meeting or Assembly in connection with the Paris Exposition of 1900."

"It is widely felt that there is not only room but need for some organisation which would bring together, for each of the leading Departments and Congresses of the Exposition, the specialist, the educationalist, and the intelligent public; and this on all grounds, from those of personal convenience, and economy of time, money, and effort, to the highest considerations of scientific progress and international amity."

Names of those willing to join the General Committee of this proposed Paris International Assembly, which, we learn, has been warmly welcomed in France, and has received a munificent beginning to a guarantee fund in Britain,

should be sent to Profs. MAVOR and GEDDES, Acting Secretaries, T. R. MARR, Assistant Secretary, 5 Old Queen Street, Westminster, London, S.W., or 95 Boulevard St. Michel, Paris.

At the Paris Exposition there is also to be an International Congress of Physics, in regard to which a prospectus has been issued.

We learn from the *Scientific American* that an aquarium will be among the attractions at the Paris Exposition. "A dark incline will lead visitors to it, and suddenly they will feel as if transported to the very bottom of the sea, in the midst of marine landscapes and inhabitants of the ocean."

At a meeting held in The Outlook Tower, Castlehill, Edinburgh, on 14th October, Prof. James Geikie, D.C.L., in the chair, an interesting and stimulating address was delivered by Prof. Wilbur Jackman, M.A., of Chicago University and Training College, on "Nature-Study, its Methods and Results in School Practice." Even apart from the able address, which will doubtless be published, the exhibits of notes of work, especially those in water-colour, arranged round the room, showed what results await those teachers who have the courage and opportunity to devise courses of nature-study to mitigate the burden of book-work. To many of those present these exhibits and the story of them must have seemed a revelation, but it was interesting to notice that several authorities who took part in the discussion, which lasted for towards two hours after the lecture, reverted to the necessity of "books." A guide-book for the teacher may be necessary—not that there is really a lack—but of more books for the scholars there should, in a case like this, be no mention. Owing to the overcrowded audience, an adjournment after the lecture was effected to the Castlehill public school, where, under the chairmanship of Prof. Crum Brown, F.R.S., an interesting discussion was held. To this contributions were made by Mr. Robert Smith, B.Sc., of University College, Dundee, who reported on some nature-study classes which he had conducted, by Mr. Robert Blair, Science Inspector, by Dr. Dunn, H.M.I.S., by Prof. J. Arthur Thomson of Aberdeen, by Dr. Maurice Paterson of the Free Church Training College, by Miss Stevenson of the Edinburgh School Board, by Mr. Walter Blaikie, Prof. Geddes of Dundee, and others.

There was also an exhibition of maps of a botanical survey of Scotland by Mr. Robert Smith, of a cosmosphere by Mr. Walter Blaikie, of a first panel of a proposed spheric atlas by Prof. E. Reclus of Brussels, of relief models by Mr. George Guyou, etc. Altogether the meeting was one of considerable educational importance in connection with the teaching of natural science in schools.

In connection with the problem which the recent codifying of "nature-study" has raised, we would be frank in remarking that "nature-study" is as difficult as it is valuable as an educational discipline, and that, the facts being as they are, the further education of the teachers (and their better remuneration, which is an obvious correlative condition) must be recognised as indispensable to success. Badly taught spelling may be bad, but it hardly affects morals; badly taught grammar may be worse, but it is rarely forcible enough to warp the outlook of a lifetime; but badly taught science by incompetent teachers is probably worse than none at all. We know full well that there are many splendidly equipped science teachers in our primary schools throughout the country, but this is certainly not, necessarily not, the case with most. To overhear a class repeating "the stomach is a bag at the end of the alimentary canal" would suffice to show even cranks for science teaching that the seamy side is distressfully ragged. And we may quote another illustration, supported by an editorial comment in our successful contemporary *The American Naturalist* for September, in which it is pointed out that *The Great Round World*, an excellent juvenile newspaper, tells the child audience that a Siberian traveller has found a beautiful flower that blossoms in January, resembling the Convolvulus, a

blossom lasting only a day, and that on the third or fourth day it has the ends of the fine anthers tipped with glistening diamond-like specks—the seeds. The *seeds, parbleu!* And this is called "Easy Science."

We learn from the very excellent September number of the *Journal of Applied Microscopy* that the Marine Biological Laboratory at Wood's Holl has just closed its twelfth annual session. The year has been a very successful one, additional courses were offered, attendance considerably increased, and a deep interest manifested. It is the purpose of the management to further broaden the scope of work. A thorough course in nature-study will be introduced next year. An addition to the botanical building and a new building for research laboratories are also expected.

The Natural History Society of Montreal has issued an appeal for financial aid. This has been rendered necessary by the discontinuance of the grant from the Quebec Government, which used to defray the cost of publishing *The Canadian Record of Science*. The Society does good work in maintaining a library and museum, the latter open free on Saturdays and on Wednesday afternoons and visited by 4000 people during the past year. Under the auspices of the Society, Saturday half-hour lectures to young people are delivered, as well as the Somerville lectures to grown-ups. The number of members is only about 170. We hope the Society will receive the support it deserves.

At the annual meeting of the Hull Scientific and Field Naturalists' Club, held on 20th September, it was stated that 54 new members had been elected during the past year, raising the membership to 165. At the fortnightly meetings during the year lectures were delivered, several dealing with local natural history. Sectional meetings were also held, and at them practical demonstrations were given by the recorders and other officers of the club. During the summer months field meetings were held as usual, and excursions made to places in the neighbourhood. By the publication of *Transactions* (previously noticed by us) the Society has been able to add to its library. A microscope club has been started to enable members to buy microscopes at reduced rates. The President for the ensuing year is Mr. R. H. Philip. The Secretaryship remains in the able hands of Mr. Thos. Sheppard, 78 Sherburn Street, Hull.

In *Science* for 29th September there are some interesting notes by "F. A. L." on "The Work of Foreign Museums." The Australian Museum leads the list in expenditure, though this only amounts to $35,000; the Colombo Museum, the official museum of Ceylon, had 111,000 visitors in 1898, and yet suffers for lack of funds and paint; the activity of the museum at Prag is shown by the numerous meetings of the association by which it is controlled and by its important publications, *e.g.* Fric's *Fauna der Gaskohle;* the West Prussian Provincial Museum is very strictly regional; the Norwich Museum likewise; the Manchester Museum is "a very live museum," but this is hardly "news."

From the Report of the Australian Museum for 1898 we glean the following information:—Few purchases were made, owing to want of funds; on the other hand, a circular appeal for objects illustrating Australian ethnology has met with a gratifying response. A large collection of miscellaneous objects from Pacific islands has been presented by Rev. S. Ella. The Rev. H. A. Robertson of Erromanga, New Hebrides, has presented a cooking-pot and two large stone rings, known as Navilah or moon-rings, of great rarity and value. There have been purchased a remarkable inlaid skull from the Solomon Islands, and a valuable series of objects from Thio, New Caledonia, including two funeral masks, shell money, and a *doigtier* or spear-thrower. In this department all the unexhibited specimens have been arranged systematically, and the phallic specimens, of which the Museum possesses a fine series, have been arranged in a private room and labelled. The zoological collections have been enriched by many specimens from the Zoological Society of New South Wales,

including a donkey brought back from the Soudan in 1885 by the New South Wales Infantry. Prof. W. B. Spencer presented several specimens of Central Australian Muridae. Mr. Waite is making a card catalogue of the mammals, and finds the plan exceedingly convenient. A new spirit house has been built, and thousands of specimens in spirit have been safely transferred to it. The detrimental practice of keeping birds' skins in spirits has now been stopped. The skeleton of a large sunfish, *Orthagoriscus mola*, is being prepared by the method used for cartilaginous skeletons. It is worthy of note that the exhibited shells have to be protected by movable covers, since their colours are bleached by the strong light. The Tunicata of New South Wales have been studied by Prof. Herdman, who has compiled a "Descriptive Catalogue of the Tunicata in the Australian Museum, Sydney, N.S.W.," printed in Liverpool, and published about midsummer last. This gives to the Museum some fifty types. Under Palaeontology it is stated that Mr. C. W. de Vis of the Queensland Museum has continued the determination of the extinct marsupial remains. The more important donations were: Mesozoic, Carboniferous, and Silurian fossils of Tasmania, by T. Stephens; Cretaceous reptilian and fish remains from the Flinders river, by J. B. Nutting; and Prof. R. Tate's co-types of Ordovician fossils from Central Australia, by W. A. Horn. The collection of meteorites has been added to by casts, slices, and a small iron meteorite from West Australia. Many Australian minerals have been presented, and among them a fine series of native copper from Broken Hill. These excerpts by no means exhaust the interest of the Report. The amount of work done under discouraging circumstances is highly creditable to the staff. It is clear they do not go to sleep, for sixteen telephones have been distributed throughout the building, "and have already proved a source of great convenience and saving of time."

Science notes that the last report of the Royal Zoological Society of Amsterdam commemorates the sixtieth year of its existence. Besides the well-known zoological garden, the Society maintains a fine aquarium, a zoological museum, a geological and palaeontological collection, a library, etc., a combination which affords fine facilities for scientific work. It will be remembered that Fürbringer's monumental work on the morphology of birds was among the publications of this Society.

On September 11, Alderman George Collard, Mayor of Canterbury, opened in that town a new institute, library, and museum, in great part the gift of the late Dr. Beaney of Melbourne.

We learn from *Nature* that a commencement has been made with the new Geological Museum at Oxford. The Museum will cost about £44,000, the fund raised at a memorial to Prof. Sedgwick supplying £27,000.

Science for September 22 quotes from the report of the Australian Museum for 1897 an interesting observation in regard to a specimen of the Galapagos tortoise, *Testudo nigrita*, brought to Sydney in 1853. It then weighed 53 pounds, while at the time of its death, in 1896, its weight had increased to 368 pounds, "a more rapid rate of growth than such animals are usually credited with." It is now mounted in the Museum.

Science reports the following gifts and bequests:—$300,000 given by Mr. Edward Tuck of New York to Dartmouth College; $60,000 bequeathed by Mrs. Mary D. Goddard to Tufts College; $10,000 bequeathed by Richard B. Westbrook of Philadelphia to the Wagner Institute of Science, to endow a lectureship for "the full and fearless discussion by the most learned and distinguished men and women in our own and other countries of mooted or disputed questions in science, and especially the theories of evolution."

We have already alluded to the fact that during last year Mr. E. R. Waite of the Australian Museum accompanied H.M. Col. S.S. *Thetis* on a trawling and

dredging cruise under the control of Mr. F. Farnell. The cruise, or rather series of four cruises, lasted from February 18 to April 9. The coast-line covered extended from Jervis Bay to the Manning River, and, except for a trip to Lord Howe Id., the greatest distance from land was 25 miles. The depths at which the trawl was lowered ranged between 10 and 90 fathoms. The fishes were the chief object of study; about 100 species represented by 365 specimens were collected, and Mr. Waite's preliminary "Scientific Report on the Fishes" was published last year as an appendix to Mr. Farnell's "Report upon Trawling Operations." Several species are new to the colony, while a few are new to science. The entire scientific collections have been deposited in the Museum, and the results will be published as a Museum Memoir, towards the expense of which £400 was voted. On the last cruise to Lord Howe Id., heavy weather was encountered, and the passage occupied seventy hours instead of the usual thirty-six. Mr. Waite and Mr. Etheridge, who also was on this trip, were left on the island for eleven days, since the *Thetis* was blown to sea in the gale. They collected here some additional very interesting remains of *Meiolania platyceps*, the peculiar extinct chelonian, which is also found in Patagonia. Also by the help of Mrs. T. Nicholls they obtained an additional collection of shells. A large number of sponges, anemones, corals, gorgonias, echinoderms, crustaceans, and polyzoa were collected during the cruise. The number of species was very great, and included many new or hitherto unrecorded from the coast of New South Wales.

Dr. Kishinouye and other Japanese zoologists have hired a two-storeyed building on the shores of the Inland Sea, with the view of converting it into a biological station.

Professor J. Ijima has returned from a zoological expedition to Formosa.

The Danish expedition to East Greenland, under the leadership of Lieut. Amdrup, returned to Copenhagen on Sept. 13. It had investigated and mapped the tract between 65° 50′ and 57° 22′ N. lat., hitherto unvisited by Europeans. At one time it was inhabited by many Esquimaux, all of whom have now perished. A collection of their skulls and other relics was brought home. Botanical, geological, and zoological observations were made, as well as anthropological measurements on living Esquimaux in other parts. Depots were left at 60° 6′ and 67° 15′ N. lat.

Dr. Carl Peters is said to have passed from Portuguese territory into Mashonaland, after making some important discoveries of mica, saltpetre, and diamonds.

Nature reports that the Imperial Russian Geographical Society and the Ministry of Agriculture have jointly arranged for a zoological exploration of the Russian coast-line of the Pacific in the Far East. The expedition will also work in conjunction with the "Society for exploring the Amur territory," and it is intended to establish a marine zoological station at Vladivostock.

The rumour is that Nansen will not undertake another north polar expedition, but that his next trip will probably be southwards. It is also rumoured that the scientific interest of the British Antarctic Expedition is being threatened by a predominance of geographical and physical considerations. It will be deplorable if the biological problems are in any way overlooked, for the most that can be said after all is that the Antarctic fauna has been touched and scratched at.

Mr. H. J. Mackinder, the Reader of Geography at Oxford, succeeded in September in reaching the summit of the hitherto unscaled Mount Kenia in British East Africa.

Major Ronald Ross and his colleagues have been very successful at Sierra Leone, having shown that certain mosquitoes (*Anopheles* sp.) there carry the

malarial germ, and that as these breed in a few stagnant pools a little energy will suffice to get rid of them and the fever at once.

Science reports the return and the success of an expedition which sailed a year ago, under the scientific direction of R. E. Snodgrass, to the Galapagos Islands and to Cocos and Clipperton Island west of Ecuador. A large collection of animals has been made.

Prof. Georg Böhm, geologist of Freiburg, has gone on leave for a year and a half on a journey to Asia, Australia, and Central America.

An association has been formed of collectors for the purpose of exploring the local lepidopterous fauna of Hildesheim and vicinity, under the title of *Verein für Schmetterlingsfreunde.* Prof. A. Radcliffe Grote of the Roemer Museum presides.

We learn from *Science* that Profs. W. Libbey and C. M'Clure of the Peary Relief Expedition have returned to Princeton with rich collections both of vertebrates and invertebrates.

The *Scientific American* of September 23 states that a year ago Cornell University secured 30,000 acres of woodland in the Adirondack Mountains for the exclusive use of her forestry department. The land has been divided into a number of sections and several seed beds have been laid out in which there has been planted over a million small trees of different varieties. The students of forestry will study the theory of the subject from October to April, and from then until Commencement they will study the practical side of forestry. Cornell University is the only college in the United States which has a forestry department. Prof. John Gifford was recently elected to the Chair of Forestry in the University.

Nature for September 28 notes that Mr. E. R. Waite has identified the "palu" or "oil-fish" of the Central Pacific as the well-known *Ruvettus pretiosus*, hitherto known only from the North Atlantic.

The *Scientific American* reports that by a fall of rock at Niagara Falls the Horseshoe Fall has been restored to the shape from which it derives its name, which it has belied of late years.

Science reports that the German Government has sent Prof. von Volkens of Berlin to the Caroline Islands to investigate the soil and the flora.

The American Association for the Advancement of Science voted a hundred dollars to Prof. Eigenmann to help in his researches on cave animals.

The *Scientific American* refers to an interesting excursion made at the close of the meeting of the American Association for the Advancement of Science. A party went to Sandusky, Kelley Island, and Put-in Bay, at which place they explored the unique and marvellous Strontia Cave, the only one of the kind known. The arches are hung with prismatic crystals of "celestite." The place was found by Mr. Gustave Heinemann, in 1897, while opening a well. Besides exhibiting his grotto, he makes money by selling specimens of the sparkling strontia. Commercially this mineral is worth twelve dollars a ton, and is used to clarify beet-sugar, and likewise in pyrotechnics, giving a vivid crimson colour to fireworks.

At the meeting of the American Association for the Advancement of Science Dr. L. O. Howard discussed "Spider-bite Stories," and noted that he had been unable to verify a single serious or fatal case. He scoffed at the "kissing-bug" craze, which he compared to the tarantula frenzy and as in great part hysterical. He blamed the newspapers for helping to create morbid nervousness.

Dr. Howard, in his paper on "Gad-Flies" at the meeting of the American Association for the Advancement of Science, noted that before the Russian entomologist Porchinki he had tried and advocated the method of destroying these insects by means of a kerosene film spread over the pools.

Three cities contended for the distinction of entertaining the meeting of the American Association for the Advancement of Science in 1900, namely, Denver, Philadelphia, and New York. The latter was decided upon. The date was fixed for June, from the 25th to the 30th, in order to suit members who may wish to attend the Paris Exposition. The president for 1900 is Prof. R. S. Woodward, of Columbia University, distinguished for his services in astronomy, geodesy, and mathematics.

The *Scientific American* notes that the director of the U.S. Geological Survey has just issued a pamplet entitled "Maps and Descriptions of Routes of Explorations in Alaska in 1898, with General Information concerning the Territory." There are ten maps, and special reports on various expeditions, general information concerning the Territory, and tabulated information, including the gold production of Alaska. The various routes and means of transportation are clearly shown. The publication is intended for widespread distribution, and copies can be obtained by the aid of Congressmen.

We learn from *Science* that in addition to $300,000 subscribed from various sources for the endowment of Brown University, on condition that $2,000,000 be collected, Mr. John D. Rockfeller, already famous for his munificence, has offered quarter of a million dollars on condition that a million be raised before the commencement of next year.

The *Scientific American* notes that the New York Zoological Society has secured from express companies a concession in rates on live animals. Formerly the cost of transporting live animals was very high, and the reduction will be a great boon to zoological gardens and the like throughout the States.

The renowned botanist and philologist, Stephan Ladislaus Endlicher, who died in 1849, was buried along with his wife Cecilia in the Matzlemsdorfer Cemetery in Vienna. On the 21st of June 1899 the bodies were removed to a worthier resting-place near the main entrance to the central Friedhof. The Rector of the University, Prof. J. Wiesner, and the Director of the Botanical Gardens, delivered short orations in praise of Endlicher's genius and the services which he rendered to botany, philology, and science in general. (See *Verh. Zool. Bot. Ges. Wien.* xlix. 1899, pp. 359-361.)